ESL-TR-13-10-04

ENERGY EFFICIENCY/RENEWABLE ENERGY IMPACT IN THE TEXAS EMISSIONS REDUCTION PLAN (TERP)

VOLUME II—TECHNICAL REPORT

Annual Report to the
Texas Commission on Environmental Quality
January 2012-December 2012

TCEQ

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October 2013
(Revised November 2013)

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

TEXAS A&M ENGINEERING
EXPERIMENT STATION

Energy Systems Laboratory

October 2, 2013

Chairman Bryan W. Shaw
Texas Commission on Environmental Quality
P. O. Box 13087
Austin, TX 78711-3087

Dear Chairman Shaw:

The Energy Systems Laboratory (Laboratory) at the Texas Engineering Experiment Station of The Texas A&M University System is pleased to provide its ninth annual report, "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)," as required under Texas Health and Safety Code Ann. § 388.003 (e), Vernon Supp. 2002 (Senate Bill 5, 77R as amended 78 R & 78S).

The Laboratory is required to annually report the energy savings from statewide adoption of the Texas Building Energy Performance Standards in Senate Bill 5 (SB 5), as amended, and the relative impact of proposed local energy code amendments in the Texas non-attainment and near-non-attainment counties as part of the Texas Emissions Reduction Plan (TERP).

Please contact me at (979) 845-1280 should you or any of the TCEQ staff have any questions concerning this report or any of the work presently being done to quantify emissions reduction from energy efficiency and renewable energy measures as a result of the TERP implementation.

Sincerely,

David E. Claridge

David E. Claridge, Ph.D., P.E.
Director

Enclosure

cc: Commissioner Toby Baker
Executive Director Zak Covar

Disclaimer

This report is provided by the Texas Engineering Experiment Station (TEES) as required under Section 388.003 (e) of the Texas Health and Safety Code and is distributed for purposes of public information. The information provided in this report is intended to be the best available information at the time of publication. TEES makes no claim or warranty, express or implied that the report or data herein is necessarily error-free. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement, recommendation, or favoring by the Energy Systems Laboratory or any of its employees. The views and opinions of authors expressed herein do not necessarily state or reflect those of the Texas Engineering Experiment Station or the Energy Systems Laboratory.

VOLUME II – TECHNICAL REPORT

Energy Efficiency/Renewable Energy Impact In The Texas Emissions Reduction Plan

Executive Summary

The Energy Systems Laboratory (Laboratory), at the Texas Engineering Experiment Station of The Texas A&M University System, in fulfillment of its responsibilities under Texas Health and Safety Code Ann. § 388.003 (e), Vernon Supp. 2002, submits its ninth annual report, Energy Efficiency/Renewable Energy (EE/RE) Impact in the Texas Emissions Reduction Plan (TERP) to the Texas Commission on Environmental Quality.

The report is organized in three volumes.

- Volume I – Summary Report – provides an executive summary and overview;
- Volume II – Technical Report – provides a detailed report of activities, methodologies and findings;
- Volume III – Technical Appendix – contains detailed data from simulations for each of the counties included in the analysis.

The ESL worked with the EPA and TCEQ regarding a new version of eGRID for all ERCOT counties in Texas. A new version of eGRID was developed and presented in this report, which is based on the ERCOT congestion management zones. As the TCEQ moved the base year to more recent years, this updated version of eGRID, representing the current Texas market, has been used to estimate the emissions reduction from wind power in the next year's report.

Accomplishments:

a. Energy Code Amendments

The Laboratory was requested by several Councils of Governments (COGs) and municipalities to analyze the stringency of several proposed residential and commercial energy code amendments, including: the 2003 and 2006 IECC and the ASHRAE Standards 90.1-2001 and 90.1-2004. Results of the analysis are included in this Volume II-Technical Report.

b. Technical Assistance

The Laboratory provided technical assistance to the TCEQ, PUCT, SECO, ERCOT, and several political subdivisions, as well as stakeholders participating in improving the compliance of the Texas Building Energy Performance Standards (TBEPS). The Laboratory also worked closely with the TCEQ to refine the integrated NOx emissions reduction calculation procedures that provide the TCEQ with a standardized, creditable NOx emissions reduction from energy efficiency and renewable energy (EE/RE) programs, which are acceptable to the US EPA. These activities have improved the accuracy of the creditable NOx emissions reduction from EE/RE initiatives contained in the TERP and have assisted the TCEQ, local governments, and the building industry with effective, standardized implementation and reporting.

c. NOx Emissions Reduction

Under the TERP legislation, the Laboratory must determine the energy savings from energy code adoption and, when applicable, from more stringent local codes or above-code performance ratings, and must report these reductions annually to the TCEQ.

Figure 1 shows the integrated NOx emissions reduction through 2020 for the electricity and natural gas savings from the various EE/RE programs.

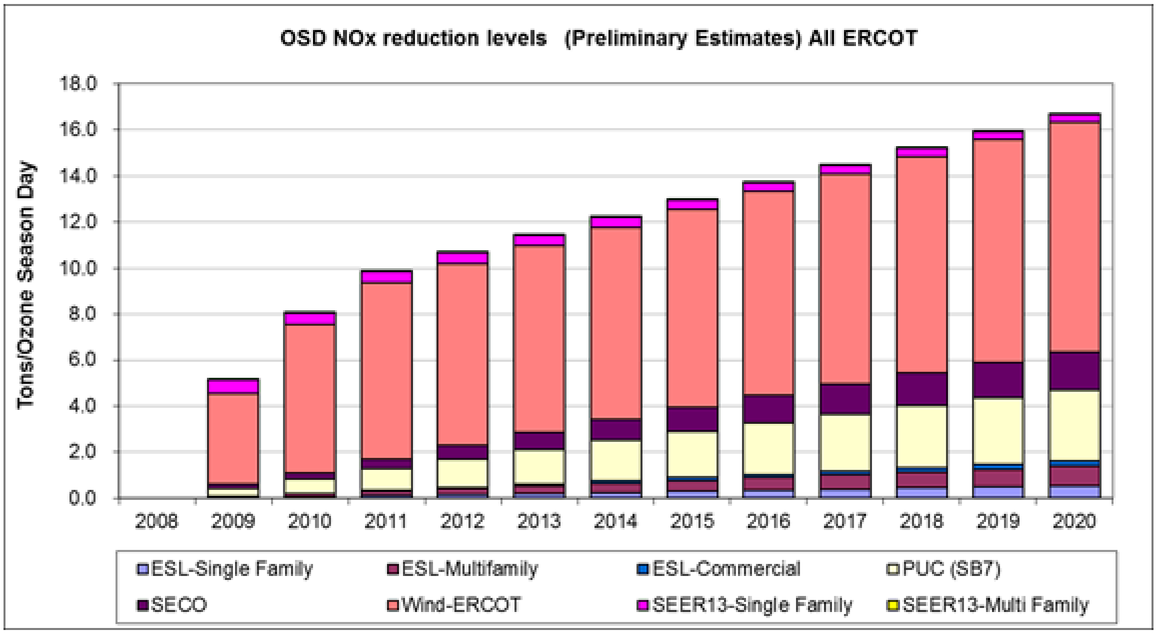

Figure 1: OSD NOx Emissions Reduction Projections through 2020 (Base Year 2008)

In 2012, (Table 1) the total integrated annual savings from all programs is 16,413,917 MWh/year. The integrated annual electricity savings from all the different programs is:

- Savings from code-compliant residential and commercial construction is 498,883 MWh/year (3.0% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program is 1,831,318 MWh/year (11.2%),
- Savings from SECO's Senate Bill 5 program is 714,891 MWh/year (4.4%),
- Electricity savings from green power purchases (wind) is 13,049,580 MWh/year (79.5%), and
- Savings from residential air conditioner retrofits[1] is 319,244 MWh/year (1.9%).

By 2013, the total integrated annual savings from all programs will be 17,661,268 MWh/year. The integrated annual electricity savings from all the different programs will be:

- Savings from code-compliant residential and commercial construction will be 682,701 MWh/year (3.9% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 2,205,082 MWh/year (12.5%),
- Savings from SECO's Senate Bill 5 program will be 909,903 MWh/year (5.2%),
- Electricity savings from green power purchases (wind) will be 13,560,301 MWh/year (76.8%), and
- Savings from residential air conditioner retrofits will be 303,282 MWh/year (1.7%).

In 2012 (Table 2), the total integrated annual NOx emissions reduction from all programs is 4,609 tons-NOx/year. The integrated annual NOx emissions reduction from all the different programs is:

- NOx emissions reduction from code-compliant residential and commercial construction is 126 tons-NOx/year (2.7% of the total NOx savings),
- NOx emissions reduction from the PUC's Senate Bill 7 programs is 522 tons-NOx/year (11.3%),
- NOx emissions reduction from SECO's Senate Bill 5 program is 221 tons-NOx/year (4.8%),
- NOx emissions reduction from green power purchases (wind) is 3,665 tons-NOx/year (79.5%), and
- NOx emissions reduction from residential air conditioner retrofits is 75 tons-NOx/year (1.6%).

[1] This assumes air conditioners in existing homes are replaced with the more efficient SEER 13 units, versus an average of SEER 11, which is slightly more efficient than the previous minimum standard of SEER 10.

By 2013, the total integrated annual NOx emissions reduction from all programs will be 4,959 tons-NOx/year. The integrated annual NOx emissions reduction from all the different programs is:

- NOx emissions reduction from code-compliant residential and commercial construction will be 172 tons-NOx/year (3.5% of the total NOx savings),
- NOx emissions reduction from the PUC's Senate Bill 7 programs will be 629 tons-NOx/year (12.7%),
- NOx emissions reduction from SECO's Senate Bill 5 program will be 277 tons-NOx/year (5.6%),
- NOx emissions reduction from green power purchases (wind) will be 3,809 tons-NOx/year (76.8%), and
- NOx emissions reduction from residential air conditioner retrofits will be 71 tons-NOx/year (1.4%).

Table 1: Annual and OSD Electricity Savings for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	0	21,748	55,268	93,760	153,171	213,417	274,548	336,614	399,668	463,763	528,956	595,303	662,861
ESL-Multifamily (MWh)	0	50,218	94,867	167,566	262,939	357,885	452,435	546,620	640,469	734,013	827,282	920,305	1,013,111
ESL-Commercial (MWh)	0	0	25,750	54,550	82,773	111,399	140,452	169,957	199,937	230,420	261,430	292,996	325,145
PUC (SB7) (MWh)	0	538,841	976,984	1,437,883	1,831,318	2,205,082	2,560,158	2,897,479	3,217,935	3,522,368	3,811,579	4,086,330	4,347,343
SECO (MWh)	0	235,216	293,537	509,616	714,891	909,903	1,095,163	1,271,161	1,438,359	1,597,197	1,748,093	1,891,444	2,027,628
Wind-ERCOT (MWh)	0	3,273,150	8,135,429	10,995,427	13,049,580	13,560,301	14,091,009	14,642,488	15,215,550	15,811,039	16,429,835	17,072,848	17,741,026
SEER13-Single Family (MWh)	0	343,330	326,163	309,855	294,362	279,644	265,662	252,379	239,760	227,772	216,383	205,564	195,286
SEER13-Multifamily (MWh)	0	29,021	27,569	26,191	24,881	23,637	22,456	21,333	20,266	19,253	18,290	17,376	16,507
Total Annual (MWh)	0	4,491,524	9,935,568	13,594,848	16,413,917	17,661,268	18,901,882	20,138,030	21,371,943	22,605,825	23,841,849	25,082,165	26,328,906

PROGRAM	OZONE SEASON DAY - OSD												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	0	124	283	468	626	787	951	1,117	1,286	1,457	1,632	1,810	1,992
ESL-Multifamily (MWh)	0	233	460	744	999	1,254	1,508	1,760	2,012	2,263	2,514	2,764	3,013
ESL-Commercial (MWh)	0	0	71	149	227	305	385	466	548	631	716	803	891
PUC (SB7) (MWh)	0	1,476	2,677	3,939	5,017	6,041	7,014	7,938	8,816	9,650	10,443	11,195	11,911
SECO (MWh)	0	644	804	1,396	1,959	2,493	3,000	3,483	3,941	4,376	4,789	5,182	5,555
Wind-ERCOT (MWh)	0	14,246	23,054	27,654	33,273	34,575	35,929	37,335	38,796	40,314	41,892	43,532	45,235
SEER13-Single Family (MWh)	0	2,445	2,323	2,207	2,097	1,992	1,892	1,798	1,708	1,622	1,541	1,464	1,391
SEER13-Multifamily (MWh)	0	195	186	176	167	159	151	144	136	130	123	117	111
Total OSD (MWh)	0	19,365	29,857	36,734	44,366	47,607	50,830	54,039	57,242	60,444	63,651	66,867	70,099

Table 2: Annual and OSD NOx Emissions Reduction Values for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL (in tons NOx)												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0	5	14	23	38	53	68	83	99	115	131	147	164
ESL-Multifamily	0	13	24	43	67	92	117	141	166	190	214	239	263
ESL-Commercial	0	0	6	14	21	28	35	42	50	57	65	73	81
PUC (SB7)	0	151	274	409	522	629	731	828	921	1,008	1,091	1,170	1,245
SECO	0	67	99	162	221	277	330	381	429	475	518	559	599
Wind-ERCOT	0	893	2,268	3,062	3,665	3,809	3,958	4,113	4,274	4,441	4,615	4,796	4,983
SEER13-Single Family	0	81	77	73	69	66	62	59	56	53	51	48	46
SEER13-Multifamily	0	7	6	6	6	6	5	5	5	5	4	4	4
Total Annual (Tons NOx)	0	1,217	2,769	3,790	4,609	4,959	5,307	5,653	5,999	6,344	6,690	7,036	7,384

PROGRAM	OZONE SEASON DAY - OSD (in tons NOx/day)												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0.00	0.03	0.07	0.11	0.15	0.19	0.23	0.28	0.32	0.36	0.40	0.45	0.49
ESL-Multifamily	0.00	0.06	0.12	0.19	0.26	0.32	0.39	0.45	0.52	0.58	0.65	0.72	0.78
ESL-Commercial	0.00	0.00	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22
PUC (SB7)	0.00	0.41	0.75	1.12	1.43	1.72	2.00	2.27	2.52	2.76	2.99	3.21	3.41
SECO	0.00	0.18	0.27	0.44	0.60	0.76	0.90	1.04	1.18	1.30	1.42	1.53	1.64
Wind-ERCOT	0.00	3.94	6.42	7.63	9.32	9.69	10.06	10.46	10.87	11.29	11.74	12.19	12.67
SEER13-Single Family	0.00	0.57	0.54	0.51	0.49	0.46	0.44	0.42	0.40	0.38	0.36	0.34	0.32
SEER13-Multifamily	0.00	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Total OSD (Tons NOx)	0.00	5.24	8.23	10.09	12.35	13.26	14.16	15.07	15.97	16.86	17.76	18.66	19.57

4. Technology Transfer

The Laboratory, along with the TCEQ, hosts the annual Clean Air Through Energy Efficiency (CATEE) conference, which is attended by top experts and policy makers in Texas and from around the country. At the conference, the latest educational programs and technology is presented and discussed, including efforts by the Laboratory, and others, to reduce air pollution in Texas through energy efficiency and renewable energy. These efforts have produced significant success in bringing EE/RE closer to US EPA acceptance in the Texas SIP. The Laboratory will continue to provide superior technology to the State of Texas through such efforts with the TCEQ and the US EPA.

To accelerate the transfer of technology developed as part of the TERP, the Laboratory has also made presentations at national, state and local meetings and conferences, which includes the publication of peer-reviewed papers. The Laboratory will continue to provide technical assistance to the TCEQ, counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering emissions and improving the air quality for all Texans.

These efforts have been recognized nationally by the US EPA. In 2007, the Laboratory was awarded a National Center of Excellence on Displaced Emissions Reduction (CEDER) by the US EPA so that these accomplishments could be rapidly disseminated to other states for their use. The benefits of CEDER include:

- Reducing the financial, technical, and administrative costs of determining the emissions reduction from EE/RE measures;
- Continuing to accelerate implementation of EE/RE strategies as a viable clean air effort in Texas and other states;
- Helping other states better identify and prioritize cost-effective clean air strategies from EE/RE; and
- Communicating the results of quantification efforts through case-studies and a clearinghouse of information.

The Energy Systems Laboratory provides the annual report, Energy Efficiency/Renewable Energy (EE/RE) Impact in the Texas Emissions Reduction Plan (TERP), to the Texas Commission on Environmental Quality (TCEQ) in fulfillment of its responsibilities under Texas Health and Safety Code Ann. § 388.003 (e), Vernon Supp. 2002. If any questions arise, please contact us by phone at 979-862-2804, or by email at terpinfo@tees.tamus.edu.

Acknowledgements

This work has been completed as a fulfillment of the requirements in Texas Health Code, Senate Bill 5, Section 388.003, and through Senate Bill 20, House Bill 2481 and House Bill 2129, which requires the Laboratory to assist TCEQ in quantifying emissions reductions credits from energy efficiency and renewable energy programs, through a contract with the Texas Environmental Research Consortium (TERC). Similarly, selected Code training workshops were funded by the US DOE through the Texas State Energy Conservation Office (SECO). Partial funding on the Texas Climate Vision project, a joint project with the City of Austin was also provided by the US DOE through SECO.

The authors are also grateful for the timely input provided by the following individuals, and agencies: Mr. Art Diem, US EPA, for providing the eGRID database and Vincent Meiller and Robert Gifford, TCEQ.

Numerous additional individuals at the Laboratory contributed significantly to this report, including, Sung Lok Do, Sukjoon Oh, Kee Han Kim, Stephen O’Neal and Ivonne Macouzet.

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1. Overview

The Energy Systems Laboratory (Laboratory), at the Texas Engineering Experiment Station of the Texas A&M University System, is pleased to provide our ninth annual report, Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP), to the Texas Commission on Environmental Quality (TCEQ) in fulfillment of its responsibilities under Texas Health and Safety Code Ann. § 388.003 (e), Vernon Supp. 2002. This annual report:

- Provides an estimate of the energy savings and NOx reductions from energy code compliance in new residential construction in all ERCOT counties;
- Provides an estimate of the standardized, cumulative, integrated energy savings and NOx reductions from the TERP programs implemented by the Laboratory, SECO, the PUC and ERCOT in all ERCOT Texas;
- Describes the technology developed to enable the TCEQ to substantiate energy and emissions reduction credits from energy efficiency and renewable energy initiatives (EE/RE) to the U.S. Environmental Protection Agency (US EPA), including the development of a web-based emissions reduction calculator; and
- Outlines progress in advancing EE/RE strategies for credit in the Texas State Implementation Plan (SIP).

The report is organized in three volumes.

Volume I – Summary Report – provides an executive summary and overview;
Volume II – Technical Report – provides a detailed report of activities, methodologies and findings; and
Volume III – Technical Appendix – contains detailed data from code-compliant energy simulations for all ERCOT counties in Texas included in the analysis.

1.1 Legislative Background

The TERP was established in 2001 by the 77th Legislature through the enactment of Senate Bill 5 to:

- Ensure that Texas air meets the Federal Clean Air Act requirements (Section 707, Title 42, United States Code); and
- Reduce NOx emissions in non-attainment and near-non-attainment counties through mandatory and voluntary programs, including the implementation of energy efficiency and renewable energy programs (EE/RE).

To achieve the clean air and emissions reduction goals of the TERP, Senate Bill 5 created a number of EE/RE programs for credit in the SIP:

- The Texas Building Energy Performance Standards (TBEPS) as the building energy code for all new residential and commercial buildings;
- A municipality or county may request the Laboratory to determine the energy impact of proposed energy code changes;
- An annual evaluation by the Public Utility Commission of Texas (PUCT), in cooperation with the Laboratory, of the emissions reduction of energy demand, peak electric loads and the associated air contaminant reductions from utility-sponsored programs established under Senate Bill 5, and utility-sponsored programs established under the electric utility restructuring act (Section 39.905 Utilities Code);
- A 5% electricity reduction goal each year for facilities of political subdivisions in non-attainment and near-non-attainment counties from 2002 through 2009; and
- Annual report to TCEQ to be provided by the Laboratory on the energy savings and resultant emissions reduction from implementation of building energy codes and which identifies the municipalities and counties whose codes are more or less stringent than the un-amended code.

Passed during the 78th Legislature (2003), HB 1365 and HB 3235 amended TERP to enhance its effectiveness with these additional energy efficiency initiatives:

- TCEQ is required to conduct outreach to non-attainment and near-non-attainment counties on the benefits of implementing energy efficiency measures as a way to meet the air quality goals under the federal Clean Air Act;
- TCEQ is required develop a methodology for computing emissions reduction from energy efficiency initiatives;
- A voluntary Energy-Efficient Building Program at the General Land Office (GLO), in consultation with the Laboratory, for the accreditation of buildings that exceed the state energy code requirements by 15% or more;

- Municipalities are allowed to adopt an optional, alternate energy code compliance mechanism through the use of accredited energy efficiency programs determined to be code-compliant by the Laboratory, as well as the US EPA's Energy Star New Homes program; and
- The Laboratory is required to develop and administer a statewide training program for municipal building inspectors seeking to become code-certified inspectors for enforcement of energy codes.

Senate Bill 5 was again amended during the 79th Legislature (2005) through SB 20, HB 2481 and HB 2129. These enhanced the effectiveness of Senate Bill 5 by adding the following energy efficiency initiatives:

- 5,880 MW of generating capacity is required from renewable energy technologies by 2015;
- 500 MW from non-wind renewables;
- The PUCT is required to establish a target of 10,000 megawatts of installed renewable capacity by 2025;
- The TCEQ is required to develop methodology for computing emissions reduction from renewable energy initiatives and the associated credits;
- The Laboratory is required to assist the TCEQ in quantifying emissions reduction credits from energy efficiency and renewable energy programs;
- The Texas Environmental Research Consortium (TERC) is required to contract with the Laboratory to develop and annually calculate creditable emissions reduction from wind and other renewable energy resources for the state's SIP; and
- The Laboratory is required to develop at least three alternative methods for achieving a 15 % greater potential energy savings in residential, commercial and industrial construction.

The 80th Legislature (2007), through SB 12, and HB 3693 further amended Senate Bill 5 to enhance its effectiveness by adding the following energy efficiency initiatives:

- The Laboratory is required to provide written recommendations to the State Energy Conservation Office (SECO) about whether or not the energy efficiency provisions of latest published edition of the International Residential Code (IRC) or the International Energy Conservation Code (IECC) are equivalent to or better than the energy efficiency and air quality achievable under the editions adopted under the 2001 IRC/IECC. The Laboratory shall make its recommendations no later than six months after publication of new editions at the end of each three-year code development cycle of the International Residential Code and the International Energy Conservation Code.
- The Laboratory is required to consider comments made by persons who have an interest in the adoption of the energy codes in the recommendations made to SECO.
- The Laboratory is required to develop a standardized report format to be used by providers of home energy ratings, including different report formats for rating newly constructed residences from those for existing residences. The form must be designed to give potential buyers information on a structure's energy performance, including: insulation; types of windows; heating and cooling equipment; water heating equipment; additional energy conserving features, if any; results of performance measurements of building tightness and forced air distribution; and an overall rating of probable energy efficiency relative to the minimum requirements of the International Energy Conservation Code or the energy efficiency chapter of the International Residential Code, as appropriate.
- The Laboratory is encouraged to cooperate with an industry organization or trade association to: develop guidelines for home energy ratings; provide training for individuals performing home energy ratings and providers of home energy ratings; and provide a registry of completed ratings for newly constructed residences and residential improvement projects for the purpose of computing the energy savings and emissions reduction benefits of the home energy ratings program.
- The Laboratory is required to include information on the benefits attained from this program in an annual report to the commission.

The 81st Legislature (2009) extended the date of the TERP to 2019 and required the TCEQ to contract with Laboratory to compute emissions reduction from wind and other renewable energy resources for the SIP.

The 82nd Legislature (2011) cut 50% of the Laboratory's funding under TERP (to take into effect in FY 2012), while the Laboratory's responsibilities under TERP increased, as new legislatively allocated energy efficiency initiatives were introduced:

- Each political subdivision, institution of higher education or state agency shall establish a goal to reduce the electric consumption by the entity by at least 5% each fiscal year for 10 years, beginning September 1, 2011. Each entity annually shall report to SECO, on forms provided by SECO, regarding the entity's goal, the entity's efforts to meet the goal, and progress the entity has made. The Laboratory is required to calculate energy savings and emissions reduction for each political subdivision, institution of higher education or state agency, based on the information collected by SECO.
- Beginning April 1, 2012, all electric cooperatives that had retail sales of more than 500,000 MWh in 2005 and all municipally owned utilities must report each year to SECO, on a standardized form developed by SECO, information regarding the combined effects of the energy efficiency activities of the electric cooperative/utility from the previous calendar year, including the annual goals, programs enacted to achieve those goals, and any achieved energy demand or savings goals. The Laboratory is required to calculate energy savings and emissions reduction for municipally owned utilities and for electric cooperatives, based on the information collected by SECO.
- SECO is required to appoint a new advisory committee for selecting high-performance building design evaluation systems. The Laboratory will send a representative to participate at the new advisory committee.
- The Laboratory may conduct outreach to the real estate industry on the value of energy code compliance and above code construction.

The 83rd Legislature (2013) kept the Laboratory’s funding under TERP at 50% of the legistlatively allocated level, while the Laboratory’s responsibilities under TERP were not similarly reduced.

1.2 Laboratory Funding for the TERP

The Laboratory expended $181,855 in FY 2002; $372,226 in FY 2003; $635,683.84 in FY 2004; $1,107,366.13 in FY 2005; $952,012.70 in 2006; $947,114.62 in FY 2007; $908,512.65 in FY 2008; $949,927.94 in FY 2009; $902,843.35 in FY 2010, $853,421.69 in FY 2011; and $434,481.91 in FY 2012 (with the 50% Legislature cut in ESL funding). In FY 2013 the Laboratory expended $447,221.42. The Laboratory has also supplemented these funds with competitively awarded Federal and State grants to provide the needed statewide training for the new mandatory energy codes and to provide technical assistance to cities and counties in helping them implement adoption of the legislated energy efficiency codes. In addition, the ESL received an award from the US EPA in the spring of 2007 to establish a Center of Excellence for the Determination of Emissions Reduction (CEDER) which has helped to enhance the EE/RE emissions calculations

1.3 Accomplishments since January 2012

Since January 2012, the Laboratory has accomplished the following:

- Calculated energy and resultant NOx reductions from implementation of the Texas Building Energy Performance Standards (IECC/IRC codes) to new residential and commercial construction for all non-attainment and near-non-attainment counties;
- Enhanced the Laboratory’s IECC/IRC Code-Traceable Test Suite for determining emissions reduction due to code and above-code programs;

- Enhanced the IC3 calculator, which is energy code compliance software based on the Texas Building Energy Performance Standards by resolving minor defects found in the model, introducing new capability to add slab and floor insulation to IC3 interface, and updating manual and illustrations;
- Continued development and testing of key procedures for validating simulations of building energy performance;
- Provided energy code training workshops, including: residential, commercial IECC/IRC energy code training sessions, ASHRAE 90.1-2010 (funded by SECO), and other educational workshops on strategies to advance high performance homes and buildings [funded by SECO and provided in collaboration with the South-central Partnership for Energy Efficiency as a Resource (SPEER)] throughout the State of Texas;
- Maintained and updated the Laboratory's Texas Emissions Reduction Plan (TERP) website;
- Maintained a builder's residential energy code Self-Certification Form (Ver.1.3) for use by builders outside municipalities;
- Analyzed the stringency of Chapter 11, 2012 International Residential Code (IRC) and the 2012 International Energy Conservation Code (IECC) versus the current Texas Building Energy Performance Standards (TBEPS), based on Chapter 11 of the 2009 IRC and the 2009 IECC. The Laboratory also reviewed and considered the 1,526 public comments collected by SECO. The Laboratory presented to SECO its final recommendation on the adoption of the 2012 code.
- Reviewed several local code proposed amendments and analyzed their stringency. For: the City of Houston and the North Central Texas Council of Governments (NCTCOG).
- Hosted the Clean Air Through Energy Efficiency (CATEE) Conference in October 2012, in Galveston, Texas. Conference sessions included key talks by the TCEQ, PUCT, ERCOT, EPA, DOE the 1st Armored Division and Fort Bliss, Texas House of representatives Oncor, several ISDs and cities, NASA, SECO and the Laboratory about quantifying emissions reduction from EE/RE opportunities and guidance on key energy efficiency and renewable energy topics;
- Provided technical assistance to the TCEQ regarding specific issues, including:
    - Enhancement of the standardized, integrated NOx emissions reduction reporting procedures to the TCEQ for EE/RE projects;
    - Enhancement of the procedures for weather normalizing NOx emissions reduction from renewable projects;
- Enhanced the web-based emissions reduction calculator, including:
    - Depreciated the 2000/2001 and 2006 IECC codes (as of 1/1/2012)
    - Added the 2009 IECC version
    - Added a version of the energy report with a signature line, as requested by some municipalities,
    - Improved the algorithm behind IC3 to make it more accurate
    - Altered the help text and images to make it clearer
    - Added optional inputs for water heaters to make the calculation more accurate.
- Participated as exhibitors at several conferences, including at the Clean Air Through Energy Efficiency Conference in Galveston, Texas, the Texas Green Home Summit in Plano, Texas, and TCEQ Environmental Trade Fair and Conference, Austin, Texas.
- Completed the study for the City of Arlington on the economic and environmental impacts of potential energy code enhancements for the city. The project identified up to 16 Energy Efficiency Measures (EEMs) for various building energy components (e.g., windows, doors, insulation; lighting; HVAC; and domestic water heating). Combinations of EEMs were used to deliver 15% above the energy code stringency. The study and recommendations included both residential and commercial new development and existing building inventory (as an option).
- Assisted SECO in the development of a form for political subdivisions, institutions of higher education and state agency to report annually on energy efficiency activities and results towards achieving the goal of at least 5% annual reduction in electric consumption.
- Assisted SECO in the development of a form for electric cooperatives that had retail sales of more than 500,000 MWh in 2005 and all municipally owned utilities, to report annually on energy efficiency activities and energy saving/demand reduction.
- Continued the development of verification procedures, including:

Worked toward the code compliance tools for commercial buildings, retail and school buildings

1.4 Technology Transfer

To accelerate the transfer of technology developed as part of the TERP program, the Laboratory:

- Delivered "Statewide Air Emissions Calculations from Wind and Other Renewables," to the Texas Commission on Environmental Quality in December 2012.
- Updated previously developed degradation analysis to determine if degradation could be observed in the measured power from Texas wind farms.
- Updated previously developed database of other renewable projects in Texas, including: solar photovoltaic, geothermal, hydroelectric, and Landfill Gas-fired Power Plants.
- Applied previously developed estimation techniques for hourly solar radiation from limited data sets.
- Along with the TCEQ and the US EPA, is host to the annual Clean Air Through Energy Efficiency (CATEE) Conference attended by top Texas experts and policy makers and national experts.
- Continued the National Center of Excellence on Displaced Emissions Reduction (CEDER) by the US EPA. The benefits of CEDER include:
    - Reducing the financial, technical, and administrative costs of determining the emissions reduction from EE/RE measures;
    - Continuing to accelerate implementation of EE/RE strategies as a viable clean air effort in Texas and other states;
    - Helping other states identify and prioritize cost-effective clean air strategies from EE/RE, and;
    - Communicating the results of quantification efforts through case-studies and a clearinghouse of information.

In addition to the tasks listed above, the Laboratory delivered presentations regarding the TERP related work, including:

- Presentation to the City of Arlington, February 2012
- Presentations to the Building Professional Institute, February & May 2012
- Presentations to the City of Corpus Christi, March 2012
- Presentation to the Sierra Club, June 2012
- Presentations at Stakeholder's meeting, July 2012 and August 2012
- Presentation to the International Building Performance Simulation Association (IBPSA), Madison, WS, August 2012
- Webinar to the Environmental Protection Agency (EPA), August 2012
- Presentations to the City of El Paso, September 2012
- Presentations to SPEER, September, October and December 2012
- Presentation to the International Conference for Enhanced Building Operations, Manchester, United Kingdom, October 2012
- Presentations to the Clean Air Through Energy Efficiency Conference, Galveston, TX, October 2012
- Presentations to The South-central Partnership for Energy Efficiency as a Resource (SPEER), September 2012, October 2012 and December 2012

Four presentations to the City of Arlington

- Mukhopadhyay, J.; Kim, H.; Do, SL.; Kim, KH; Baltazar, J-C; Haberl, J.; Lewis, C. 2011 "Cost-Effective Energy Efficiency Measures for Above Code (ASHRAE 90.1-2001 and 2007) Restaurant Buildings in the City of Arlington," City of Arlington and Stakeholders, February 2012
- Kim, H.; Do, SL.; Baltazar, J-C; Haberl, J.; Lewis, C. 2011 "Cost-Effective Energy Efficiency Measures for Above Code (2003 and 2009 IECC) Residential Buildings in the City of Arlington," City of Arlington and Stakeholders, February 2012

- Kim, H.; Do, SL; Kim, KH; Baltazar, J-C; Haberl, J.; Lewis, C. 2011 "Cost-Effective Energy Efficiency Measures for Above Code(ASHRAE 90.1-2001 and 2007) Small Retail Buildings in the City of Arlington," City of Arlington and Stakeholders, February 2012
- Kim, H.; Do, SL.; Kim, KH; Baltazar, J-C; Haberl, J.; Lewis, C. 2011 "Cost-Effective Energy Efficiency Measures for Above Code (ASHRAE 90.1-2001 and 2007) Small Office Buildings in the City of Arlington," City of Arlington and Stakeholders, February 2012

Presentation of one paper at the 12th International Conference for Enhanced Building Operations, held in Manchester, UK, October 2012

- Yazdani, B.; Haberl,J.; Kim, H.; Baltazar, J.C.; Zilbershtein,G. 2012 "Statewide Emissions Reduction, Electricity and Demand Savings from the Implementation of Building-Energy-Codes in Texas," *Proceedings of the 12th International Conference for Enhanced Building Operations,* Manchester, United Kingdom

Three presentations to the Clean Air Through Energy Efficiency Conference held in Galveston, Texas, October 2012.

- Kim, H.; Haberl, J.; Mukhopadhyay, J.; Baltazar, J.C.; Do, S.; Kim, K.; Yazdani, B.; Yarborough, J., 2012 "Energy Efficiency / Renewable Energy (EE/RE) Projects in Texas Public Schools: Top Four Measures," *Clean Air Through Energy Efficiency Conference,* Galveston, Texas, October 2012
- Haberl, J.; Yazdani, B.; Culp, 2012 "Emissions Reduction Impact of Renewables," *Clean Air Through Energy Efficiency Conference,* Galveston, Texas, October 2012
- Haberl, J.; Yazdani, B.; Culp, 2012 "Texas Emissions Reductions Program (TERP) Energy Efficiency/Renewable Energy (EE/RE) Update," *Clean Air Through Energy Efficiency Conference,* Galveston, Texas, October 2012

The Laboratory has and will continue to provide leading-edge technical assistance to the TCEQ, counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering emissions and improving the air quality for all Texans. The Laboratory will continue to provide superior technology to the State of Texas through efforts with the TCEQ and US EPA. The efforts taken by the Laboratory have produced significant success in bringing EE/RE closer to US EPA acceptance in the SIP. These activities were designed to more accurately calculate the creditable NOx emissions reduction from EE/RE initiatives contained in the TERP and to assist the TCEQ, local governments, and the building industry with standardized, effective implementation and reporting.

1.5 Energy and NOx Reductions from New Residential and Commercial Construction, Including Residential Air Conditioner Retrofits

State adoption of the energy efficiency provisions of the International Residential Code (IRC) and International Energy Conservation Code (IECC) became effective September 1, 2001. The Laboratory has developed and delivered training to assist municipal inspectors to become certified energy inspectors. The Laboratory also supported code officials with guidance on interpretations as needed. This effort, based on a requirement of HB 3235, 78th Texas Legislature, supports a more uniform interpretation and application of energy codes throughout the state. In general, the State is experiencing a true market transformation from low energy efficiency products to high energy efficiency products. These include: low solar heat gain windows, higher efficiency appliances, high efficiency air conditioners and heat pumps, increased insulation, lower thermal loss ducts and in-builder participation in "above-code" code programs such as Energy Star New Homes, which previously had no state baseline and almost no participation.

In 2012, the following savings were calculated:

- In 2012, the annual electricity savings from code-compliant residential and commercial construction is calculated to be 498,883 MWh/year (3.0% of the total electricity savings),
- Savings from residential air conditioner retrofits[2] is 319,244 MWh/year (1.9%).

- In 2012, the OSD electricity savings from code-compliant residential and commercial construction is calculated to be 1,852 MWh/day (4.2%),
- Savings from residential air conditioner retrofits are 2,264 MWh/day (5.1%).

- By 2013, the annual electricity savings from code-compliant residential and commercial construction is calculated to be 682,701 MWh/year (3.9% of the total electricity savings),
- Savings from residential air conditioner retrofits will be 303,282 MWh/year (1.7%).

- By 2013, the OSD electricity savings from code-compliant residential and commercial construction is calculated to be 2,346 MWh/day (4.9%),
- Savings from residential air conditioner retrofits will be 2,151 MWh/day (4.5%).

- In 2012, the annual NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 126 tons-NOx/year (2.7% of the total NOx savings),
- Savings from residential air conditioner retrofits is 75 tons-NOx/year (1.6%).

- In 2012, the OSD NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 0.47 tons-NOx/day (3.8%),
- Savings from residential air conditioner retrofits are 0.53 tons-NOx/day (4.3%).

- By 2013, the NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 172 tons-NOx/year (3.5% of the total NOx savings),
- Savings from residential air conditioner retrofits will be 71 tons-NOx/year (1.4%).

- By 2013, the OSD NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 0.59 tons-NOx/day (4.5%),
- Savings from residential air conditioner retrofits will be 0.50 tons-NOx/day (3.8%).

1.6 Integrated NOx Emissions Reductions Reporting Across State Agencies

In 2005, the Laboratory began to work with the TCEQ to develop a standardized, integrated NOx emissions reduction across state agencies implementing EE/RE programs so that the results can be evaluated consistently. As required by the legislation, the TCEQ receives the following reports:

- From the Laboratory – savings from code compliance and renewables;
- From the Laboratory, in cooperation with the Electric Reliability Council of Texas (ERCOT), the savings from electricity generated from wind power;
- From the Public Utilities Commission of Texas (PUCT) on the impacts of the utility-administered programs designed to meet the mandated energy efficiency goals of SB7 and SB5; and

[2] This assumes air conditioners in existing homes are replaced with the more efficient SEER 13 units, versus an average of SEER 11, which is slightly more efficient than the previous minimum standard of SEER 10.

- From the State Energy Conservation Office (SECO) on the impacts of energy conservation in state agencies and political subdivisions.

The total integrated annual and OSD electricity savings for all the different programs in the integrated format was calculated using the adjustment factors shown in Table 3 for 2009 through 2020 as shown in Table 1. Annual and OSD NOx emissions reduction from the electricity savings (presented in Table 1) for all the programs in the integrated format is shown in Table 2.

In 2012, the total integrated annual savings from all programs is 16,413,917 MWh/year. The integrated annual electricity savings from all the different programs is:

- Savings from code-compliant residential and commercial construction is 498,883 MWh/year (3.0% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program is 1,831,318 MWh/year (11.2%),
- Savings from SECO's Senate Bill 5 program is 714,891 MWh/year (4.4%),
- Electricity savings from green power purchases (wind) is 13,049,580 MWh/year (79.5%), and
- Savings from residential air conditioner retrofits[3] is 319,244 MWh/year (1.9%).

In 2012, the total integrated OSD savings from all programs is 44,366 MWh/day, which would be a 1,849 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs is:

- Savings from code-compliant residential and commercial construction is 1,852 MWh/day (4.2%),
- Savings from the PUC's Senate Bill 7 programs is 5,017 MWh/day (11.3%),
- Savings from SECO's Senate Bill 5 program is 1,959 MWh/day (4.4%),
- Electricity savings from green power purchases (wind) are 33,273 MWh/day (75.0%), and
- Savings from residential air conditioner retrofits are 2,264 MWh/day (5.1%).

By 2013, the total integrated annual savings from all programs is 17,661,268 MWh/year. The integrated annual electricity savings from all the different programs is:

- Savings from code-compliant residential and commercial construction is 682,701 MWh/year (3.9% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program is 2,205,082 MWh/year (12.5%),
- Savings from SECO's Senate Bill 5 program is 909,903 MWh/year (5.2%),
- Electricity savings from green power purchases (wind) is 13,560,301 MWh/year (76.8%), and
- Savings from residential air conditioner retrofits is 303,282 MWh/year (1.7%).

By 2013, the total integrated OSD savings from all programs is 47,607 MWh/day, which would be a 1,984 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs is:

- Savings from code-compliant residential and commercial construction is 2,346 MWh/day (4.9%),
- Savings from the PUC's Senate Bill 7 programs is 6,041 MWh/day (12.7%),
- Savings from SECO's Senate Bill 5 program is 2,493 MWh/day (5.2%),
- Electricity savings from green power purchases (wind) are 34,575 MWh/day (72.6%), and
- Savings from residential air conditioner retrofits are 2,151 MWh/day (4.5%).

In 2012, the total integrated annual NOx emissions reduction from all programs is 4,609 tons-NOx/year. The integrated annual NOx emissions reduction from all the different programs is:

- NOx emissions reduction from code-compliant residential and commercial construction is 126 tons-NOx/year (2.7% of the total NOx savings),
- NOx emissions reduction from the PUC's Senate Bill 7 programs is 522 tons-NOx/year (11.3%),
- NOx emissions reduction from SECO's Senate Bill 5 program is 221 tons-NOx/year (4.8%),

[3] This assumes air conditioners in existing homes are replaced with the more efficient SEER 13 units, versus an average of SEER 11, which is slightly more efficient than the previous minimum standard of SEER 10.

- NOx emissions reduction from green power purchases (wind) is 3,665 tons-NOx/year (79.5%), and
- NOx emissions reduction from residential air conditioner retrofits is 75 tons-NOx/year (1.6%).

In 2012, the total integrated OSD NOx emissions reduction from all programs is 12.35 tons-NOx/day. The integrated OSD NOx emissions reduction from all the different programs is:
- NOx emissions reduction from code-compliant residential and commercial construction is 0.47 tons-NOx/day (3.8%),
- NOx emissions reduction from the PUC's Senate Bill 7 programs is 1.43 tons-NOx/day (11.6%),
- NOx emissions reduction from SECO's Senate Bill 5 program is 0.60 tons-NOx/day (4.9%),
- NOx emissions reduction from green power purchases (wind) are 9.32 tons-NOx/day (75.5%), and
- NOx emissions reduction from residential air conditioner retrofits are 0.53 tons-NOx/day (4.3%).

By 2013, the total integrated annual NOx emissions reduction from all programs will be 4,959 tons-NOx/year. The integrated annual NOx emissions reduction from all the different programs is:
- NOx emissions reduction from code-compliant residential and commercial construction will be 172 tons-NOx/year (3.5% of the total NOx savings),
- NOx emissions reduction from the PUC's Senate Bill 7 programs will be 629 tons-NOx/year (12.7%),
- NOx emissions reduction from SECO's Senate Bill 5 program will be 277 tons-NOx/year (5.6%),
- NOx emissions reduction from green power purchases (wind) will be 3,809 tons-NOx/year (76.8%), and
- NOx emissions reduction from residential air conditioner retrofits will be 71 tons-NOx/year (1.4%).

By 2013, the total integrated OSD NOx emissions reduction from all programs is 13.26 tons-NOx/day. The integrated OSD NOx emissions reduction from all the different programs is:
- NOx emissions reduction from code-compliant residential and commercial construction will be 0.59 tons-NOx/day (4.5%),
- NOx emissions reduction from the PUC's Senate Bill 7 programs will be 1.72 tons-NOx/day (13.0%),
- NOx emissions reduction from SECO's Senate Bill 5 program will be 0.76 tons-NOx/day (5.7%),
- NOx emissions reduction from green power purchases (wind) will be 9.69 tons-NOx/day (73.1%), and
- NOx emissions reduction from residential air conditioner retrofits will be 0.50 tons-NOx/day (3.8%).

Table 3: Adjustment Factors used for the Calculation of the Annual and OSD NOx Savings for the Different Programs

	ESL- Single Family	ESL- Multi Family	ESL- Commercial	PUC (SB7)	SECO	Wind-ERCOT	SEER13 Single Family	SEER13 Multi Family
Annual Degradation Factor	2.00%	2.00%	2.00%	5.00%	5.00%	0.00%	5.00%	5.00%
T&D Loss	7.00%	7.00%	7.00%	7.00%	7.00%	0.00%	7.00%	7.00%
Initial Discount Factor	20.00%	20.00%	20.00%	25.00%	60.00%	10.00%	20.00%	20.00%
Growth Factor	3.25%	1.54%	3.25%	0.00%	0.00%	Actual Rates	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	See note 7	Yes	Yes

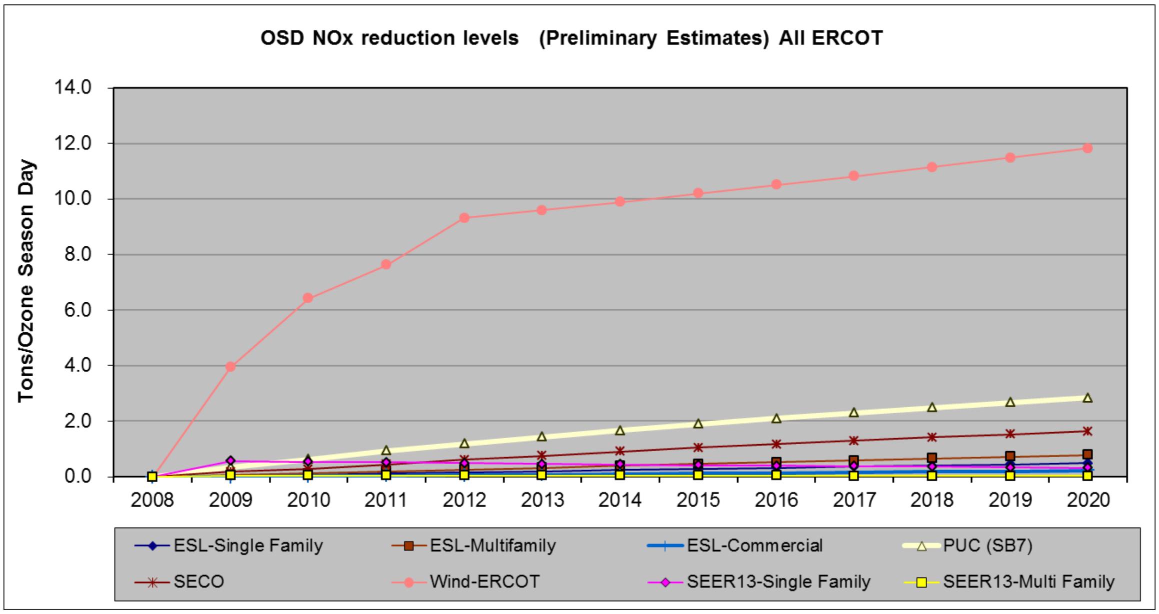

Figure 2: Integrated OSD NOx Emissions Reduction Projections through 2020 (Base Year 2008)

1.7 Technology for Calculating and Verifying Emissions Reduction from Energy Used in Buildings

In 2004 and 2005, the Laboratory developed a web-based Emissions Reduction Calculator, known as "*eCalc*," which contains the underlying technology for determining NOx emissions reduction from power plants that generate the electricity for the user[4]. The emissions reduction calculator is being used to calculate emissions reduction for consideration for SIP credits from energy efficiency and renewable energy programs in the TERP.

In 2007, the Laboratory enhanced the calculator to provide additional functions and usability, including:

- Renaming the product IC3 v2.0
- Enhanced the Laboratory's IECC/IRC Code-Traceable Test Suite for determining emissions reduction due to code and above-code programs;
- Enhanced web-based emissions calculator, including:
  - Use of the calculator to determine 15% above code residential and commercial options.
  - Gathered, cleaned and posted weather data archive for 17 NOAA stations;
  - Performed comparative testing of the calculator vs. other, non-web-based simulation programs;
  - Developed and tested radiant barrier simulation;
  - Using the web-based emissions calculator, started development of the derivative version Texas Climate Vision calculator for the City of Austin;
- Continued the development of verification procedures, including:
  - Completed the calibrated simulation of a high-efficiency office building in Austin, Texas;
  - Continued work to develop a calibrated simulation of an office building in College Station; and
  - Continued work to develop a calibrated simulation of a K-12 school in College Station;

In 2008, work on both web based calculators continued;

- Deployed IC3 v3.2 to handle a wider selection of single family building configurations (http://ic3.tamu.edu);
- Delivered TCV v1.0 to the City of Austin for their testing;
- Continued to operate the original eCalc;
- Supported modeling efforts by building enhanced tools for batch simulation;
- Provided training on both IC3 and TCV.

[4] eCalc reports NOx, SOx and CO2 emissions reduction from the US EPA eGRID database for power providers in the ERCOT region.

In 2009, IC3 developments included:

- A sister product, AIM was created for the State Comptroller's office.
- Usage statistics continue to climb.
- Updated to v3.6 which included 3 story houses, external cladding, more sophisticated ceiling/roof models, enhanced foundation modeling and the ability to copy projects

In 2010 there were several software updates including:

- IC3
  - 3.9.0 – Slab Insulation Support
  - 3.7.0 – 3.8.0 First Version of Multifamily Released along with numerous tweaks and fixes
  - 3.6.2 – New Building Model Integrated, Updated Artwork and Illustrations
- DDP
  - 1.7.05 – Added Heat Reject Recording for Electric and Gas
- Web Reports and Texas Building Registry
  - Registry 0.x – First versions of the Web Reports on TCV, eCalc, and IC3
  - Registry 1.0 – City and County Reports
  - Registry 1.1 – Cross-linked Reports for City and County
  - IC3 Reports 1.0 – Updated Certificate Reports which replace Registry 1.1 and evolve into the Texas Building Registry

The 2011 software updates include:

- IC3
  - 3.9.4 – Added approval workflow to start a new 2009 IECC job as further refinements were needed to the BDL
  - 3.9.5 – Various IECC 2009 fixes and refinements implemented
  - 3.9.6 – Updated BDL to 4.01.08, SHGC max does not apply to Climate Zone 4, 0.35 ACH minimum to all projects, Ventilation Fans added to % Air Conditioning Calculation
  - 3.9.7 - Corrected Certificate and Status screens to reflect insulation and floor construction.
  - 3.9.8- Set minimum R-value for insulated sheathing to R-2;
  - 3.10.0 - Updated and corrected problems with several text and value fields; Corrected and printed MF and SF Certificates;
  - 3.10.3 - Changed Certificate to Energy Audit Report; Added a new Certificate to be printed out; Added Inspector's list for a project; Added Pagination in projects page
  - 3.11.0 12/22/2011-Added Austin Energy 2009 IECC Energy Code Support
- Web Reports and Texas Building Registry
  - TBR Reports 1.0.5 – Added 4 new reports
  - TBR Reports 1.0.6 – Added 9 new reports
  - Registry 2.0 – Included 7 new Parameterized reports

The 2012 software updates include:

- IC3
  - 3.12 – Deprecated the 2000/2001 and 2006 Code (as of 1/1/2012)
  - 3.12.1 – Added a version of the energy report with a signature line, as requested by some municipalities. Improved the algorithm.
  - 3.12.2 – Alter help text to be more clear. Improved the algorithm.
  - 3.12.3 – Alter help pictures to make them clearer.

- 3.12.4 – Added optional input for water heaters to allow for better detail. Updated user manual. Improved the transform algorithms.

1.8 IC3 Texas Building Registry (TBR)

1.8.1 Background

In 2008, the 81st Texas Legislature amended the Texas Administrative Code (TAC .§388.008, 2009) to develop a Registry of Above-Code homes. The Laboratory built the first version of the Registry in 2009. This preliminary version allowed The Laboratory to provide basic metrics on usage of the Laboratory's above code calculators, *IC3*[5] and *TCV*[6]. By running reports against the calculator's databases, The Laboratory could determine calculator usage by month for Texas' Cities and Counties. These reports allowed a better understanding of how builders were adopting the calculators across the State so the Laboratory could improve the calculators.

Figure 3 shows the Projects and Certificates issued each month since January 2012. A Project is a house plan, while Certificates are printed reports given to the building official - assuming that the house is at or above code. In 2012, some users entered a basic floor plan and re-cycled it to generate more certificates. Figure 4 shows that more projects were entered (and presumably did not pass) than certificates created.

Figure 3: *IC3* 2012 Certificates and Projects

Figure 4: *IC3* 2012 Users vs. Certificates shows the cumulative Users and Certificates for 2012. The divergence between the two lines emphasizes the difference between the projects completed and certificates issued.

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[5] International Code Compliance Calculator, a web based, above code calculator for single family, detached, new construction in Texas.

[6] Texas Climate Vision, a web based, above code calculator for single family, detached, new construction in Austin Energy's service area.

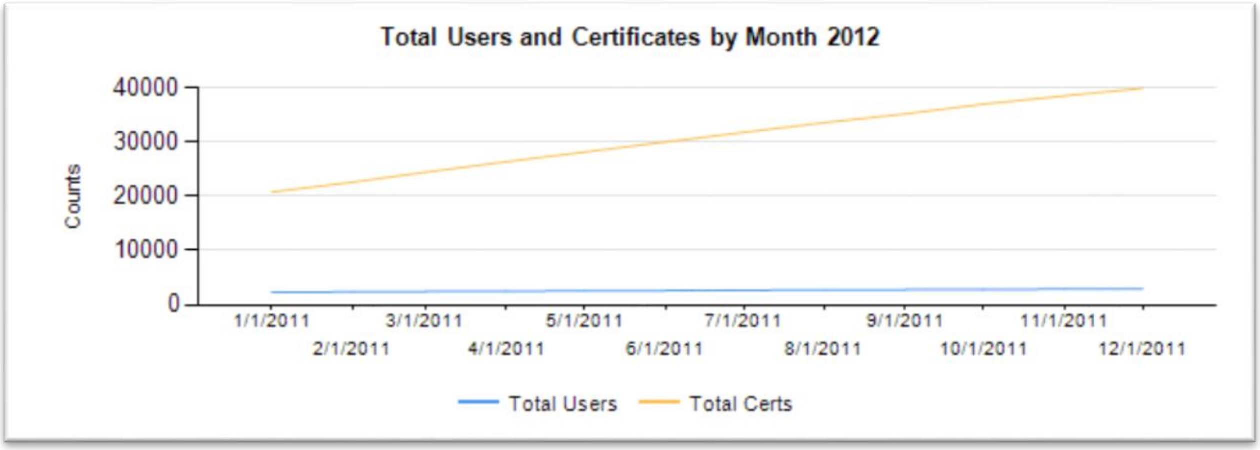


Figure 4: *IC3* 2012 Users vs. Certificates

Figure 5 shows that the largest adopter of the *IC3* software was the North Central Texas Council of Governments (NCTCOG) area, specifically, users building in Dallas, Collin, Denton, and Tarrant Counties.

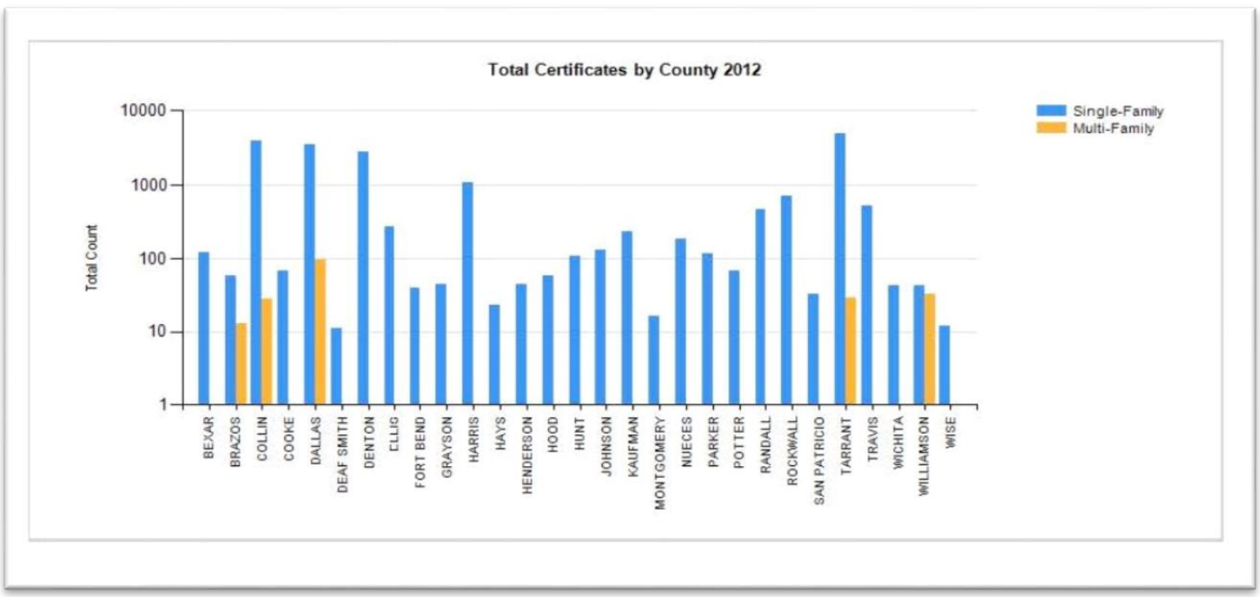


Figure 5: *IC3* 2012 Certificates – Counties with at least 10 Certificates

Figure 6 shows the certifications issued by city.

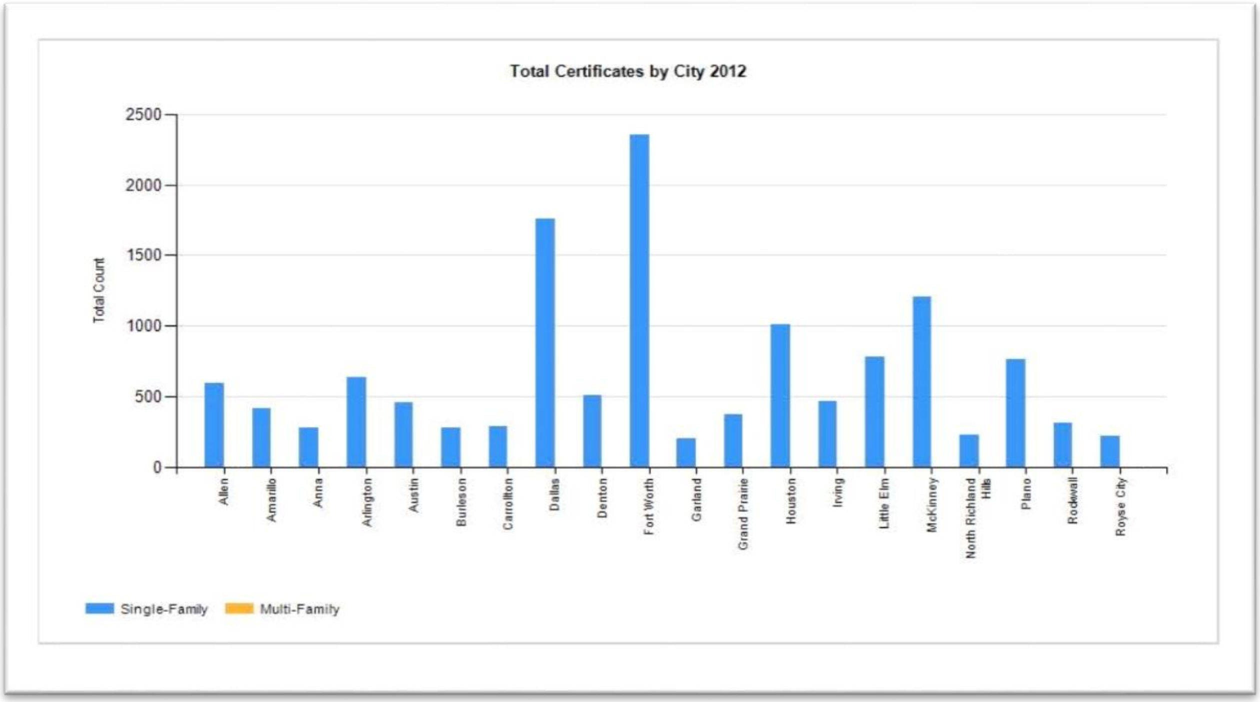


Figure 6: *IC3* 2012 Certificates – Cities with at least 200 Certificates

1.8.2 TBR Current Version

As illustrated below and a "*Report on the Development of the Format for a Texas Residential Registry* (Gilman, et al., 2008), the underlying database was optimized for supporting the *IC3* and *TCV* calculators and therefore needed a transformation to allow for seamless reporting. Consequently, The Laboratory has been steadily adding reporting capability and has been making software changes to reflect the new reporting requirements and analysis capabilities. The underlying technology of the *IC3* and *TCV* calculators is *Microsoft SQL Server 2008*. This product offers reporting capabilities through various tools.

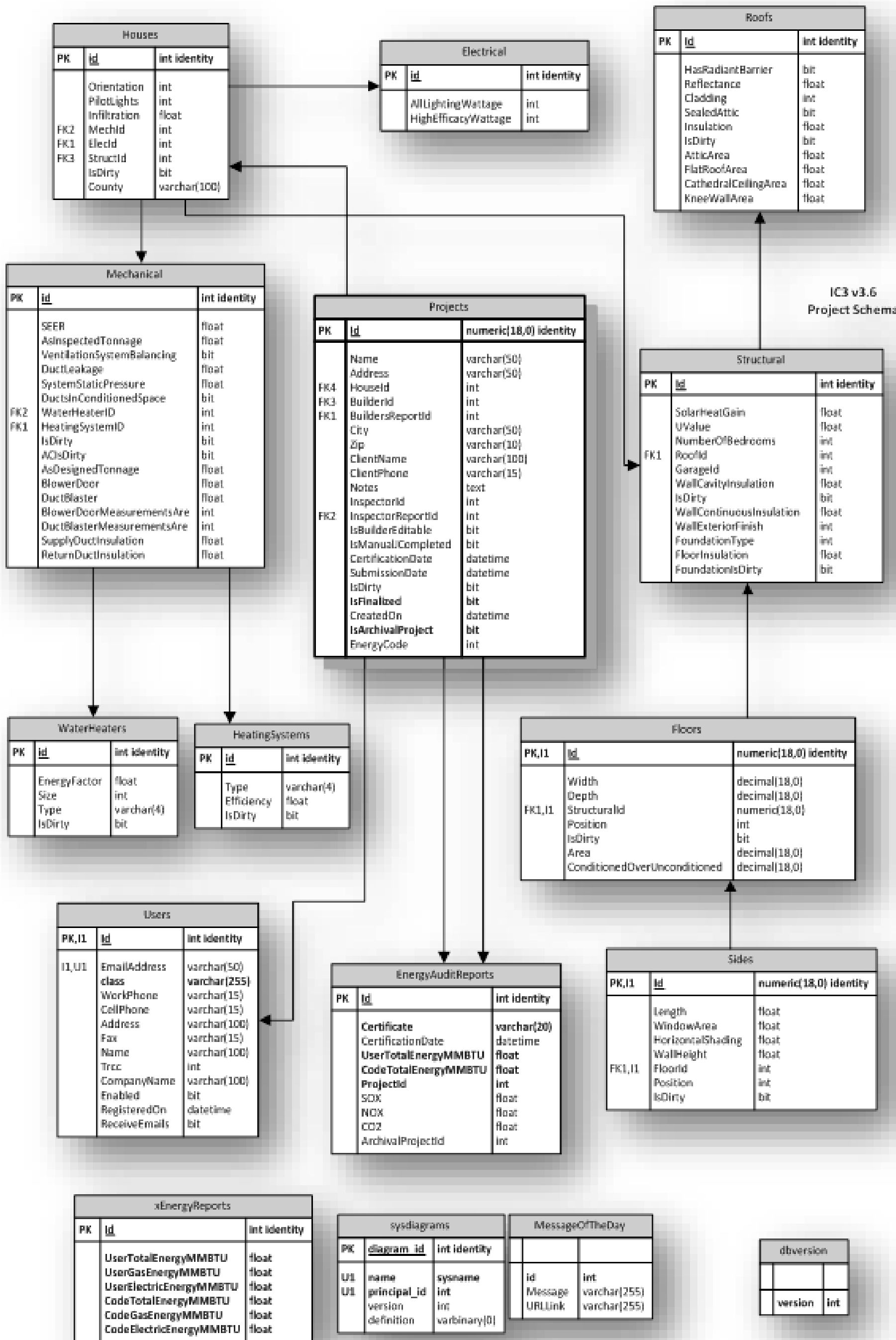


Figure 7: Database Schema

Figure 7: Database Schema shows the "layout" of the IC3 (v3.x) and TCV[7] (v1.1) databases. It gives a rough overview of the different tables (called "entities") found in the *IC3* database. The center entity is the Project, which

[7] The *TCV* v1.1 database has different fields due to the built-in inspection module and the fact it was completed two years earlier than the described *IC3* v3.6.

is the center of the *IC3* software's abstraction of a house. The other tables include floors, walls, electrical, and systems.

1.8.3 Usage Reports

Figure 8 shows a steady growth from the start of record keeping (July 2009) until the end of 2012. During this year, ESL conducted several workshops and was able to detect a correlation between workshops and IC3 usage.

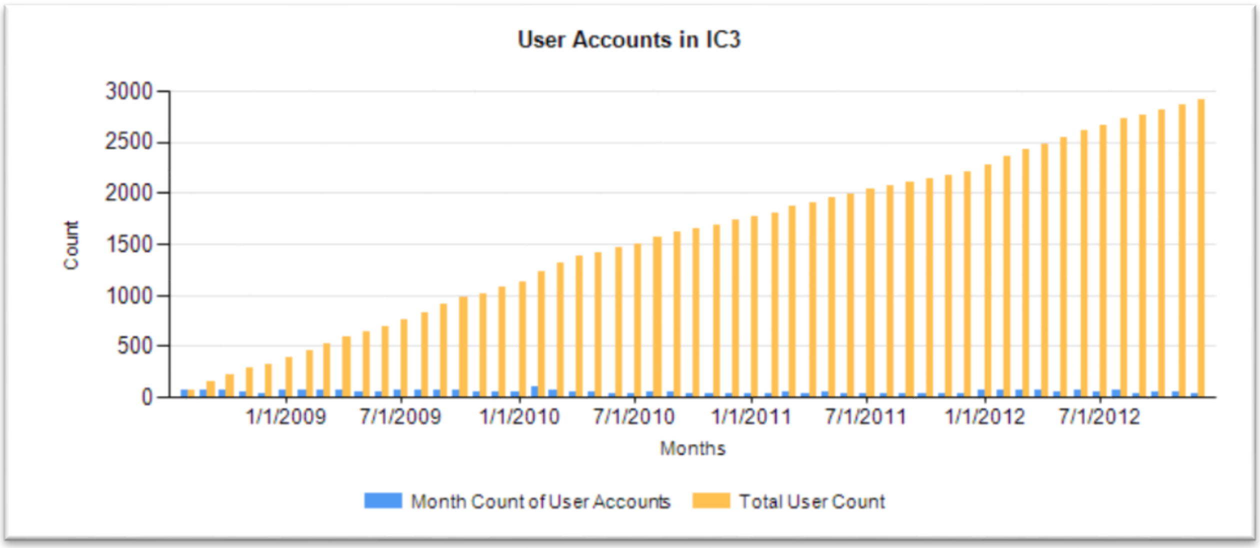


Figure 8: IC3 Usage Growth in 2012

Figure 9 shows the correlation between users and their successful projects (i.e. those that generate certificates). The graph shows that users were generating more certificates, and were doing so at a much faster rate than the rate of adding new users.

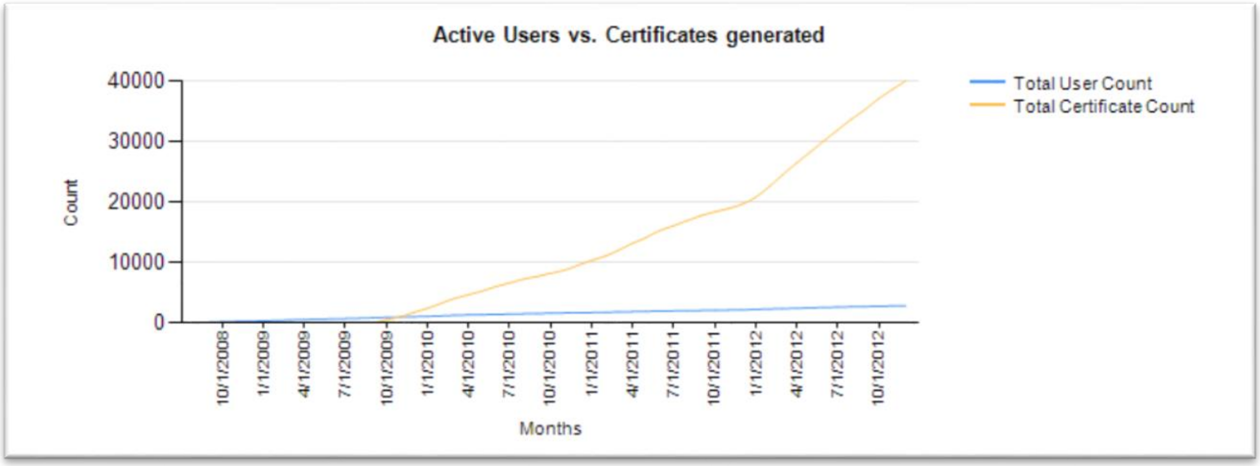


Figure 9: Users and Certificates 2012

Figure 10 through Figure 14 show where the usage was using Counties and Cities as the grouping entity. The North Central Texas Council of Governments (NCTCOG) led the way in usage during 2012.

Counties Generating Single Family IC3 Certificates in 2012

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
ANDERSON	0	1	0	0	0	0	0	0	0	0	0	0	1
ANDREWS	0	0	0	0	0	0	0	0	0	2	0	0	2
BANDERA	0	0	0	2	0	0	0	0	0	0	0	0	2
BELL	0	0	4	0	0	3	0	0	0	0	0	0	7
BEXAR	0	2	8	7	8	9	17	9	6	19	8	26	119
BRAZORIA	0	0	0	0	0	3	0	0	0	0	0	0	3
BRAZOS	11	2	0	4	0	2	3	0	21	2	4	8	57
CARSON	0	0	0	0	0	0	0	0	1	0	0	0	1
COLLIN	187	358	330	396	372	404	319	328	327	366	268	295	3950
COLLINGSWORTH	0	0	1	0	0	0	0	0	0	0	0	0	1
COMAL	0	0	0	0	5	0	0	0	0	0	0	0	5
COOKE	0	0	14	17	6	7	2	6	8	2	0	5	67
DALLAS	222	328	353	368	296	311	367	316	299	285	261	198	3604
DEAF SMITH	0	0	0	0	4	0	3	0	0	3	1	0	11
DENTON	147	214	317	229	290	160	271	262	200	265	215	228	2798
ELLIS	15	41	34	21	29	31	11	33	19	25	10	10	279
FORT BEND	0	0	6	4	0	2	2	11	5	4	5	0	39
GALVESTON	1	0	2	3	0	0	0	0	0	0	0	0	6
GRAY	0	0	0	0	0	0	0	0	0	0	0	1	1
GRAYSON	4	2	0	7	1	1	0	7	5	7	5	6	45
HARRIS	46	75	41	118	93	129	69	123	69	102	122	101	1088
HAYS	0	14	0	0	1	1	6	0	0	0	0	1	23
HENDERSON	0	4	5	3	0	5	4	0	2	16	5	1	45
HOOD	7	3	2	5	8	6	6	0	3	7	2	9	58
HOUSTON	2	0	0	0	0	0	0	0	0	0	0	0	2
HUNT	16	27	7	8	6	19	11	6	3	3	1	0	107
HUTCHINSON	0	0	0	0	0	0	0	0	0	0	1	0	1
JOHNSON	6	8	15	9	7	11	11	14	18	5	16	8	128
KAUFMAN	7	12	22	30	48	29	10	15	33	6	13	8	233
KIMBLE	0	0	1	0	0	0	0	0	0	0	0	0	1
LIBERTY	0	0	0	0	0	0	0	0	0	0	1	1	2
LUBBOCK	0	0	0	0	0	0	0	0	2	3	0	0	5
MCLENNAN	0	0	0	0	0	0	0	0	0	2	0	0	2
MONTGOMERY	0	6	3	0	0	1	0	1	0	3	0	2	16
NUECES	12	11	29	28	20	12	12	11	12	13	14	10	184
OCHILTREE	0	0	0	0	0	0	0	0	1	0	0	0	1
PALO PINTO	0	0	0	0	0	0	0	0	0	0	2	0	2
PARKER	9	12	12	9	9	12	9	15	6	16	2	5	116
POTTER	2	3	0	2	11	12	9	6	12	4	0	7	68
RAINS	0	0	0	0	0	1	0	0	0	0	0	0	1
RANDALL	34	105	49	37	24	36	23	16	20	33	48	43	468
ROCKWALL	17	47	65	59	51	78	70	109	48	43	69	49	705
SAN PATRICIO	3	3	2	8	0	4	1	0	3	4	2	3	33
SCURRY	0	0	0	0	0	0	0	0	1	0	0	0	1
SMITH	0	0	0	0	0	0	0	0	0	1	0	0	1
TARRANT	345	392	460	438	425	504	452	443	367	419	359	288	4892
TAYLOR	0	0	0	0	0	0	0	2	2	1	0	0	5
TRAVIS	10	91	39	65	7	56	20	47	58	46	61	13	513
TYLER	0	0	0	0	0	0	0	2	0	0	0	0	2
VAN ZANDT	0	0	1	0	0	0	0	0	0	0	0	0	1
WALKER	0	0	3	0	2	0	0	0	0	0	0	0	5
WASHINGTON	3	0	0	0	0	0	0	0	0	0	0	0	3
WICHITA	11	6	1	2	3	1	3	2	6	2	0	5	42
WILLIAMSON	0	2	0	17	8	1	6	0	1	1	0	6	42
WISE	0	4	0	0	0	0	0	0	0	1	3	4	12
WOOD	0	0	0	1	0	0	0	0	0	0	0	0	1
YOUNG	0	2	0	0	0	0	0	0	0	0	0	0	2

Figure 10: Counties Generating Single Family IC3 Certificates in 2012

Counties Generating Multi-Family IC3 Certificates in 2012

	Jan	Feb	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
BRAZOS	0	0	0	0	4	1	2	0	2	0	3	1	13
CASTRO	0	0	0	0	0	0	0	4	0	0	0	0	4
COLLIN	0	0	0	0	1	0	25	1	0	1	0	0	28
DALLAS	42	0	6	13	5	0	0	3	11	0	4	12	96
DENTON	0	0	3	0	0	0	0	0	0	0	0	0	3
GRAYSON	0	0	0	0	0	0	0	3	0	0	0	0	3
HARRIS	0	0	1	0	0	0	3	0	0	0	0	0	4
HOOD	0	0	0	0	0	7	0	0	0	0	0	0	7
RANDALL	0	0	0	0	0	0	0	0	6	0	1	0	7
TARRANT	0	0	1	5	7	4	0	1	6	2	3	0	29
TRAVIS	0	0	0	0	0	0	0	0	2	1	1	1	5
WILLIAMSON	0	11	0	0	0	0	0	0	4	0	0	17	32

Figure 11: Counties Generating Multi-Family IC3 Certificates in 2012

Cities Generating Single-Family IC3 Certificates in 2012

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Dallas	0	1	2	0	0	0	0	0	0	0	0	0	3
Fort Worth	0	1	0	0	0	0	0	0	0	0	0	0	1
Houston	0	0	0	0	0	0	0	0	0	2	0	0	2
Irving	4	0	1	0	0	0	0	0	0	0	0	0	5
Irving	0	0	0	1	0	1	0	0	0	0	0	0	2
Abilene	0	0	0	0	0	0	0	0	2	0	0	0	2
Abilene	0	0	0	0	0	0	0	2	0	1	0	0	3
Addison	1	0	0	2	0	0	0	0	0	0	0	0	3
Aledo	0	0	2	4	0	2	0	0	2	3	0	0	13
Allen	35	54	45	62	41	41	29	34	60	99	73	21	594
Alvarado	0	0	0	0	0	3	0	0	0	0	0	0	3
Amarillo	27	83	30	25	31	40	30	18	30	27	38	40	419
Andrews	0	0	0	0	0	0	0	0	0	2	0	0	2
Anna	3	18	13	17	22	43	18	30	24	36	21	31	276
Argyle	0	0	1	0	1	0	0	2	2	7	4	2	19
Arlington	18	19	31	53	40	82	89	85	67	50	53	51	638
Athens	0	0	3	0	0	0	0	0	0	0	0	0	3
Aubrey	0	14	4	15	16	4	25	0	0	0	0	0	78
Aubrey	0	0	0	0	0	0	0	0	0	0	14	7	21
Austin	7	88	19	59	6	54	17	44	51	42	58	12	457
Autin	0	0	0	0	0	0	0	0	2	0	3	0	5
Azle	0	0	0	0	3	0	0	0	0	4	2	1	10
Balch Springs	1	3	0	0	0	9	0	5	0	1	0	0	19
Bandera	0	0	0	2	0	0	0	0	0	0	0	0	2
Bartonville	0	0	0	0	0	0	0	0	2	0	0	0	2
BAYTOWN	0	0	0	1	0	0	0	0	0	0	0	0	1
Bedford	0	0	0	0	0	0	0	1	1	0	0	0	2
Bellaire	6	0	0	1	1	0	0	2	0	0	0	1	11
Benbrook	10	4	30	21	7	2	10	12	11	4	2	12	125
Brenham	3	0	0	0	0	0	0	0	0	0	0	0	3
Bryan	0	0	0	0	0	0	0	0	0	0	0	3	3
Burleson	16	19	32	28	21	27	13	41	33	18	22	10	280
Burleston	0	0	0	1	1	0	0	0	0	0	0	0	2
Burlington	0	0	0	0	0	4	0	0	0	0	0	0	4
Bushland	0	0	0	0	0	0	1	1	0	0	0	0	2
Canyon	9	25	19	14	4	9	1	3	2	10	11	10	117
Carrollton	13	33	37	23	27	16	15	34	31	30	19	10	288
Carrolton	0	1	8	14	4	2	2	3	0	0	0	0	34
CEDAR HILL	1	0	0	3	5	6	0	3	0	0	1	0	19
Cedar Hill	0	0	7	0	0	0	1	0	0	0	0	2	10
Cedar Hills	0	0	0	0	0	0	0	0	0	0	2	1	3
CEDARHILL	0	0	0	0	2	1	0	1	1	0	0	0	5
Celina	4	25	1	3	7	16	0	6	4	5	1	2	74
Chandler	0	0	0	0	0	0	0	0	0	0	3	0	3
Chapel Hill	0	0	0	0	2	0	0	0	0	3	0	0	5
Cochrill Hill	0	0	0	0	0	0	0	0	1	0	0	0	1
College Station	11	2	0	4	0	2	3	0	21	2	4	5	54
Colleyville	14	5	13	11	15	27	11	7	7	9	9	7	135
Conroe	0	0	0	0	0	0	0	0	0	0	5	0	5
Copeville	0	0	0	0	0	4	0	0	0	0	0	0	4
Coppell	2	7	19	12	4	5	6	4	2	4	8	2	75
Copper Canyon	0	0	0	0	0	0	0	0	0	0	0	1	1

Figure 12: Cities Generating Single Family IC3 Certificates in 2012

Corinth	5	2	6	1	1	0	3	0	0	0	0	0	18
Corpus Christi	12	11	29	28	20	12	12	11	12	13	14	10	184
Crandall	0	15	7	22	28	1	1	9	4	0	4	3	94
Crandell	2	0	1	0	3	0	0	0	0	0	0	0	6
Cross Roads	0	0	1	1	0	1	0	45	1	0	0	0	49
Cross Roads	0	0	0	0	0	0	10	0	0	0	0	0	10
Crossroads	0	0	0	0	0	0	0	0	0	0	0	2	2
Crowley	4	10	3	2	11	3	6	8	2	3	4	12	68
Cypress	0	0	0	0	0	0	0	2	0	1	0	0	3
Dallas	159	158	214	156	151	141	190	0	114	129	131	87	1630
Dallas	0	0	0	0	0	0	0	132	0	0	0	0	132
Dalllas	0	0	0	0	0	3	0	0	0	0	0	0	3
Dalworthington Gardens	0	0	1	0	0	0	0	1	0	1	0	0	3
Dayton	0	0	0	0	0	0	0	0	0	0	1	1	2
Denison	4	2	0	0	0	0	0	0	0	0	2	0	8
Denton	14	23	74	47	77	16	31	64	28	55	34	43	506
DeSoto	7	3	1	3	5	6	9	21	13	1	0	8	77
Dish	0	4	0	0	0	0	0	0	0	0	0	0	4
Double Oak	0	0	0	0	0	0	0	0	0	5	0	1	6
Dripping Springs	0	0	0	0	0	0	2	0	0	0	0	0	2
Duncancille	0	0	0	0	0	0	0	0	1	0	0	0	1
Duncancville	0	0	1	0	0	0	0	0	0	0	0	0	1
Duncanville	3	0	5	1	3	1	0	1	0	0	8	5	27
Ennis	0	0	0	1	0	0	0	0	0	0	0	0	1
Euless	0	10	1	3	6	18	7	0	6	7	1	0	59
Fairview	0	23	2	0	2	17	5	4	1	0	10	3	67
Fairview	2	0	0	0	0	0	0	0	0	0	0	0	2
Farmers Branch	0	0	0	9	5	0	0	1	0	1	0	0	16
Fate	1	9	30	10	16	18	14	26	15	9	9	11	168
Flower Mound	17	17	16	9	16	26	21	5	13	13	7	34	194
Flowermound	0	0	0	0	0	0	0	3	0	0	0	2	5
Flowermound	0	0	0	0	0	0	0	0	2	0	0	0	2
Foreny	0	0	0	0	0	0	0	0	1	0	0	0	1
Forest Hill	0	0	0	0	0	0	3	0	0	0	0	0	3
Forney	3	2	6	13	9	17	12	9	34	12	9	7	133
Forrest Hill	0	0	0	0	0	3	0	0	0	0	0	0	3
Fort Worth	198	226	228	199	203	223	193	188	150	218	194	138	2358
FORTWORTH	0	0	0	0	4	0	0	7	0	0	0	0	11
Friendswood	0	0	2	0	0	0	0	0	0	0	0	0	2
Frisco	0	4	24	11	2	1	5	7	3	1	2	9	69
Ft Worth	7	1	0	0	11	25	0	6	27	0	30	20	127
Ft Worth	0	0	7	8	0	0	39	0	0	19	0	0	73
Ft. Worth	0	3	6	0	0	1	2	0	0	0	0	1	13
Gainesville	0	0	14	17	6	7	1	6	9	2	0	4	66
Gainseville	0	0	0	0	0	0	0	0	0	0	0	1	1
Gainsville	0	0	0	0	0	0	1	0	0	0	0	0	1
Galveston	0	0	0	3	0	0	0	0	0	0	0	0	3
garden ridge	0	0	0	0	5	0	0	0	0	0	0	0	5
Garland	0	15	14	0	31	19	0	21	3	11	24	9	147
Garland	11	0	0	23	0	0	21	0	0	0	0	0	55
Glenn Heights	0	0	0	0	0	0	0	0	0	0	0	2	2
Godley	0	0	0	0	0	0	1	0	0	0	0	0	1
Graford	0	0	0	0	0	0	0	0	0	0	2	0	2
Graham	0	2	0	0	0	0	0	0	0	0	0	0	2
Granbury	7	3	2	5	8	6	9	0	3	2	2	9	56
Grand Praire	0	0	0	0	0	0	2	0	0	0	0	0	2
Grand Prairie	10	44	33	35	46	32	24	0	33	36	30	10	333
Grand Prairie	0	0	0	0	0	0	0	37	0	0	0	0	37
Grand Prarie	0	0	0	0	0	0	0	0	0	2	0	0	2
Grandbury	0	0	0	0	0	0	0	1	0	5	0	0	6
Grapevine	2	11	2	1	1	4	7	3	9	0	2	5	47

Figure 12: Cities Generating Single Family IC3 Certificates in 2012 (continued)

Greenville	1	2	1	0	0	1	9	2	0	0	1	0	17
Gun Barrel City	0	0	2	3	0	5	1	0	1	15	3	1	31
Gunter	0	0	0	0	0	0	0	0	0	4	0	0	4
Gunter	0	0	0	0	0	1	0	0	0	0	0	0	1
Hackberry	4	5	0	5	8	6	16	4	6	0	1	0	55
Harker Heights	0	0	4	0	0	0	0	0	0	0	0	0	4
Haslet	1	4	2	3	2	6	3	2	0	6	2	2	33
Haslett, TX	0	3	0	0	0	0	0	0	0	0	0	0	3
Health	0	0	0	0	0	1	0	0	0	0	0	0	1
Heartland	0	1	3	2	4	1	0	0	0	0	0	0	11
Heath	3	2	6	9	11	4	12	6	5	5	8	8	79
Helotes	0	0	0	0	0	0	0	0	0	1	0	0	1
Hereford	0	0	0	0	4	0	3	0	0	3	1	0	11
Hewitt	0	0	0	0	0	0	0	0	0	0	1	0	1
Hickory Creek	0	0	0	0	0	0	0	0	0	0	2	0	2
Highland Park	4	5	3	3	4	3	13	10	1	4	8	5	63
Highland Village	0	2	5	0	1	2	0	0	3	0	1	2	16
Houston	43	66	37	110	90	122	67	115	68	95	101	97	1011
Houston, TX	0	0	0	0	0	0	0	0	0	2	0	0	2
Hudson Oaks	0	6	0	4	6	6	6	6	2	5	1	3	45
Huffman	0	4	0	0	1	0	0	0	0	1	0	0	6
humble	0	1	0	5	0	1	1	0	0	0	0	0	8
Hurst	1	0	0	3	0	1	0	2	0	1	0	0	8
Hurst	0	0	0	0	2	0	0	0	0	0	0	0	2
Irving	6	35	58	53	29	39	37	55	56	54	24	21	467
Jarrell	0	2	0	0	0	0	0	0	0	1	0	0	3
Josaphine	2	4	3	1	8	8	0	2	1	0	1	1	31
Josephine	1	2	3	0	2	7	0	0	0	0	0	0	15
Joshua	0	0	0	0	0	0	2	0	0	0	3	0	5
Justin	0	0	0	0	0	0	0	1	0	0	0	0	1
Katy	0	0	0	0	0	0	0	1	0	0	4	5	10
Kaufman	1	0	5	0	7	6	2	0	0	0	0	0	21
Keller	0	10	7	19	12	16	8	4	10	11	12	4	113
Kennedale	0	0	0	0	0	1	0	0	2	0	0	0	3
Kingswood	0	0	2	0	0	0	0	0	0	0	0	0	2
Kingwood	0	5	2	1	0	1	1	3	4	3	4	1	25
Krum	2	7	6	2	2	3	6	5	4	6	7	18	68
La Porte	0	0	0	0	0	3	0	0	0	0	0	0	3
Lake Dallas	0	0	0	0	0	0	0	0	0	1	0	0	1
Lakewood Village	0	0	0	8	0	0	0	0	0	0	0	0	8
Lancaster	0	12	7	1	1	10	19	5	21	5	5	5	91
Lantana	0	0	3	0	1	5	3	1	4	1	2	0	20
Lavon	2	2	0	1	0	10	16	4	4	1	2	11	53
League City	1	0	0	0	0	0	0	0	0	0	0	0	1
Lewisville	4	8	2	5	14	6	15	19	15	14	38	0	140
Lewisville	0	0	0	0	0	0	0	0	0	0	0	10	10
Lexington	0	0	1	0	0	0	0	0	0	0	0	0	1
Little Elm	73	70	123	0	73	55	56	49	0	64	0	41	604
Little Elm	0	0	0	71	0	0	0	0	63	0	40	0	174
Lubbock	0	0	0	0	0	0	0	0	2	3	0	0	5
Lucas	8	7	3	6	3	9	12	13	7	8	6	13	95
Mabank	0	0	0	0	0	1	0	0	0	0	0	0	1
Malakoff	0	4	0	0	0	0	3	0	1	1	0	0	9
Mansfield	10	21	24	18	25	19	13	16	12	17	17	7	199
Manuel	0	0	0	0	0	2	0	0	0	0	0	0	2
MASTER	2	5	1	8	2	2	6	5	2	9	4	5	51
Mc Kinney	0	0	0	0	1	0	1	0	0	0	0	0	2
McKinney	52	81	100	145	123	139	110	97	96	111	82	67	1203
McLendon Chisholm	0	0	0	0	0	0	0	0	0	1	1	0	2
McLendon-Chisholm	0	0	0	0	0	0	0	0	1	2	0	4	7
Melissa	17	31	18	13	26	26	11	12	14	4	8	19	199

Figure 12: Cities Generating Single Family IC3 Certificates in 2012 (continued)

Mesquite	0	9	0	0	4	5	2	3	13	7	8	0	51
Midloathian	0	1	0	0	0	2	0	0	0	0	0	0	3
Midlothian	9	9	15	5	10	15	1	9	14	23	7	2	119
Missouri City	0	0	0	0	0	0	1	7	4	3	2	0	17
Moore	0	0	0	0	0	0	2	0	0	0	0	0	2
Murphy	2	3	2	2	3	1	1	2	2	3	2	30	53
N Richland Hills	0	0	3	0	0	0	0	0	0	0	1	0	4
N. Richland Hills	0	0	1	6	1	2	0	1	0	1	2	0	14
New Hope	0	0	0	1	0	0	0	0	0	0	0	0	1
North Lake	0	0	0	0	0	0	0	0	4	0	0	0	4
North Richland Hills	34	15	18	16	28	12	20	17	17	31	10	11	229
not sure	0	1	0	0	0	0	0	0	0	0	0	0	1
NRH	0	0	0	0	0	0	1	0	0	0	0	0	1
Oak Point	0	0	0	4	9	2	0	6	6	8	8	1	44
Oak Pointe	0	0	0	0	0	0	3	0	0	3	1	0	7
Paloma Creek	0	0	0	0	0	3	0	0	0	0	0	0	3
Pampa	0	0	0	0	0	0	0	0	0	0	0	1	1
Panhandle	0	0	0	0	0	0	0	0	1	0	0	0	1
Pantego	0	0	0	0	0	5	4	0	0	0	0	2	11
Parker	0	0	2	0	0	3	0	1	1	0	2	1	10
Pasadena	0	0	0	0	0	0	0	0	0	0	3	0	3
Pearland	0	0	0	0	0	1	0	0	0	0	0	0	1
Perryton	0	0	0	0	0	0	0	0	1	0	0	0	1
Piney Point	0	0	0	0	0	2	0	0	0	0	0	0	2
Plano	42	44	85	88	92	47	66	74	73	63	36	54	764
Ponder	0	0	6	0	0	0	0	0	0	0	0	0	6
Portland	0	3	2	8	0	0	0	0	3	4	2	3	25
Portland	3	0	0	0	0	4	1	0	0	0	0	0	8
Princeton	10	18	14	16	13	12	3	3	9	12	10	6	126
Princteon	0	0	0	0	0	1	0	0	0	0	0	0	1
Prosper	2	3	11	3	4	0	0	4	1	10	0	0	38
Providence	14	14	19	28	19	7	11	7	13	10	5	10	157
Quinlan	0	0	0	1	0	0	0	0	0	0	0	0	1
Red Oak	2	4	14	4	2	0	3	5	1	0	0	0	35
Rhome	0	0	0	0	0	0	0	0	0	0	2	0	2
Richardson	5	17	4	39	4	15	26	5	23	10	12	11	171
Roanoke	0	0	0	0	0	0	0	0	0	2	1	0	3
Roanoke	4	0	0	0	0	0	0	0	0	0	0	0	4
Rockwall	11	39	16	23	17	37	27	56	24	15	31	22	318
Rockwall County	0	0	0	0	0	1	0	0	0	0	0	0	1
Rockwall Tx.	0	0	0	0	0	1	0	0	0	0	0	0	1
Round Rock	0	0	0	0	8	1	0	0	0	0	0	6	15
Rowlett	0	5	0	0	2	7	13	14	0	10	1	8	60
Royce City	0	0	0	1	1	0	0	1	0	0	0	0	3
Royce City	0	0	0	0	0	0	1	0	0	0	3	1	5
Roys City	0	0	0	0	0	0	0	0	0	2	0	0	2
Royse City	17	25	19	23	14	34	25	26	11	12	14	3	223
Runaway Bay	0	0	0	0	0	0	0	0	0	1	1	4	6
Sachse	0	6	2	3	5	7	8	4	5	5	0	0	45
Sachse	0	0	0	0	0	0	0	0	0	0	0	3	3

Figure 12: Cities Generating Single Family IC3 Certificates in 2012 (continued)

Saginaw	4	4	6	4	2	6	0	2	0	2	0	1	31
salado	0	0	0	0	0	3	0	0	0	0	0	0	3
San Antonio	0	2	8	7	8	9	17	9	6	18	8	26	118
San Marcos	0	14	0	0	0	1	0	0	0	0	0	0	15
Sanger	0	0	0	1	4	4	4	0	2	6	2	7	30
Sansom Park	0	0	0	1	0	0	0	0	0	0	0	0	1
Savannah	1	10	4	12	10	0	9	1	2	15	8	12	84
Seagovile	0	0	0	0	0	1	0	0	0	0	0	0	1
Seagoville	2	7	4	1	3	14	0	6	3	1	0	6	47
Shady Shores	0	0	0	0	0	0	1	0	0	0	0	0	1
Shenandoah	0	0	0	0	0	0	0	0	0	3	0	2	5
Shendandoah	0	6	3	0	0	1	0	1	0	0	0	0	11
Sherman	0	0	0	0	0	0	0	7	0	0	0	0	7
Snyder	0	0	0	0	0	0	0	0	1	0	0	0	1
South Lake	0	0	0	0	0	0	0	1	0	4	0	0	5
South Lake	0	0	0	0	0	2	1	0	0	0	0	0	3
Southlake	19	2	22	27	14	13	15	17	21	17	15	12	194
Southlake, Tx.	0	0	2	0	0	0	0	0	0	0	0	0	2
Spring Valley	0	0	0	0	0	0	0	0	0	0	1	0	1
SUGAR LAND	0	0	0	0	0	0	0	0	0	0	1	0	1
Sugarland	0	0	6	2	0	2	1	4	1	1	2	0	19
Sunnyvale	2	2	1	0	0	1	3	1	0	0	0	1	11
Taylor	0	0	0	17	0	0	6	0	1	0	0	0	24
Terrell	2	0	0	1	0	0	0	2	1	1	2	0	9
The Colony	0	0	0	3	2	0	3	0	0	0	2	0	10
This is a test	0	0	0	1	0	0	0	0	0	0	0	0	1
Tioga	0	0	0	0	3	0	0	0	0	0	1	0	4
Trophy Club	1	28	29	13	22	11	42	24	5	11	5	6	197
Tyler	0	0	0	0	0	0	0	0	0	1	0	0	1
Univ Park	0	1	0	0	0	0	0	0	0	0	0	0	1
Univeristy Park	1	0	0	0	0	0	0	0	0	0	0	1	2
Univeristy Park	0	0	0	0	0	1	0	0	0	0	0	0	1
University Park	4	7	2	21	5	4	8	6	7	7	2	4	77
Unveristy Park	0	0	0	0	0	0	1	0	0	0	0	0	1
Unversity Park	0	0	0	0	0	2	0	0	0	0	0	0	2
Van Alstyne	0	0	0	7	1	0	0	5	6	3	3	7	32
Venus	0	0	0	1	3	0	1	1	0	0	1	3	10
Waco	0	0	0	0	0	0	0	0	0	2	0	0	2
Waxachie	0	3	1	1	4	1	1	1	0	0	0	0	12
Waxahachie	5	18	8	2	9	4	5	13	3	2	3	6	78
Way	0	2	0	0	0	0	0	0	0	0	0	0	2
Weaherford	0	0	0	0	0	0	0	0	1	1	0	0	2
Weatherford	9	6	6	0	1	4	3	9	1	3	0	2	44
West Lake Hills	0	0	0	0	0	0	0	0	3	0	0	0	3
West University	0	0	0	0	1	0	0	0	0	0	3	0	4
West University Place	0	0	0	2	0	0	0	0	0	0	0	0	2
Westlake	1	4	1	0	0	0	0	6	0	0	0	0	12
Westlake	0	0	0	0	0	1	6	0	0	0	0	16	23
Westover Hills	1	0	0	0	0	0	0	1	0	0	0	0	2
Westworth	0	0	0	0	0	0	0	0	0	2	0	0	2
Westworth Village	0	0	0	0	0	0	0	0	0	0	0	2	2
Wichita Falls	11	6	1	2	3	1	3	2	6	2	0	5	42
wills point	0	0	1	0	0	0	0	0	0	0	0	0	1
Wimberley	0	0	0	0	1	0	4	0	0	0	0	1	6
Winnsboro	0	0	0	1	0	0	0	0	0	0	0	0	1
Wylie	8	30	10	16	10	9	10	25	17	10	12	24	181

Figure 12: Cities Generating Single Family IC3 Certificates in 2012 (continued)

Cities Generating Multi-Family IC3 Certificates in 2012

	Jan	Feb	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
	0	0	1	0	0	0	0	0	0	0	0	0	1
Allen	0	0	0	0	1	0	0	0	0	0	0	0	1
Austin	0	0	0	0	0	0	0	0	2	1	1	1	5
Bryan	0	0	0	0	3	0	1	0	0	0	2	1	7
canyon	0	0	0	0	0	0	0	0	6	0	1	0	7
College Station	0	0	0	0	1	1	1	0	2	0	1	0	6
Dallas	42	0	2	13	5	0	0	3	11	0	4	4	84
Denton	0	0	3	0	0	0	0	0	0	0	0	0	3
Dimmitt	0	0	0	0	0	0	0	4	0	0	0	0	4
Fort Worth	0	0	1	5	7	3	0	1	3	2	2	0	24
granbury	0	0	0	0	0	7	0	0	0	0	0	0	7
HOUSTON	0	0	0	0	0	0	3	0	0	0	0	0	3
Irving	0	0	4	0	0	0	0	0	0	0	0	4	8
Jarrell	0	11	0	0	0	0	0	0	0	0	0	0	11
Keller	0	0	0	0	0	1	0	0	3	0	1	0	5
McKinney	0	0	0	0	0	0	25	0	0	0	0	0	25
Plano	0	0	0	0	0	0	0	1	0	0	0	0	1
Richardson	0	0	0	0	0	0	0	0	0	0	0	4	4
Round Rock	0	0	0	0	0	0	0	0	4	0	0	17	21
Sherman	0	0	0	0	0	0	0	3	0	0	0	0	3
Wylie	0	0	0	0	0	0	0	0	0	1	0	0	1

Figure 13: Cities Generating Multi-Family IC3 Certificates in 2012

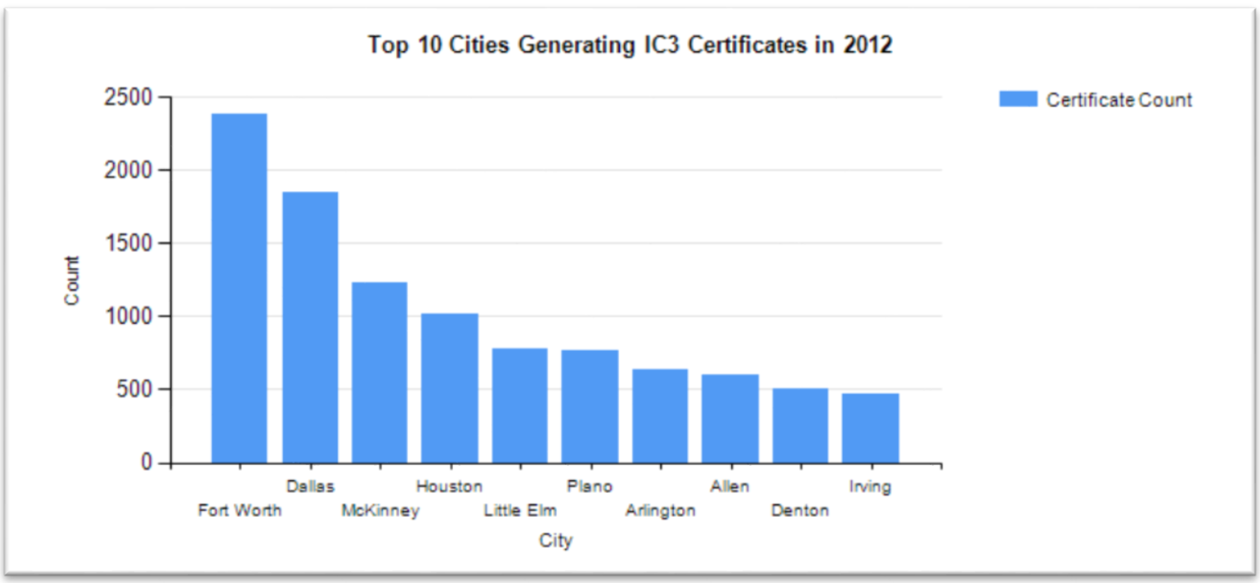


Figure 14: Top 10 Cities Generating Certificates in 2012

1.8.4 Parameter Reports

A unique and valuable use of the Registry is to look at building trends across the state.

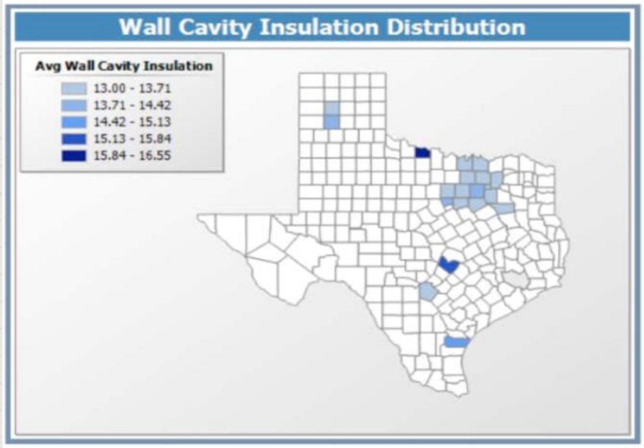
Yearly Average Wall Cavity Insulation Distribution for 2012

Overall Data Statistics derived from a subset of Counties having house count > 10

	Total Count	Average Wall Cavity Insulation	Standard Deviation
Single Family	12637	13.78	1.91
Multi Family	472	17.03	2.44

Single Family

County	Avg Wall Cavity	House Count
Harris	16.55	540
Wichita	15.97	29
Travis	15.68	187
San patricio	15.00	24
Nueces	14.98	120
Randall	14.16	301
Dallas	13.98	2219
Hood	13.91	38
Denton	13.69	1918
Cooke	13.61	28
Collin	13.56	2689
Johnson	13.52	68
Potter	13.49	55
Henderson	13.47	19
Tarrant	13.40	3247
Rockwall	13.35	475
Grayson	13.25	24
Fort bend	13.21	28
Bexar	13.19	78
Ellis	13.11	237
Parker	13.10	59
Hunt	13.06	64
Kaufman	13.00	190



Multi Family

County	Avg Wall Cavity	Unit Count
Dallas	18.46	272
Williamson	15.41	175
Tarrant	12.68	25

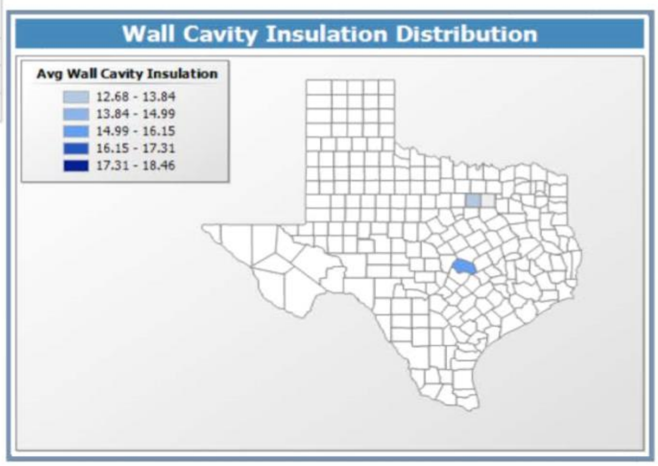


Figure 15: Average Wall Cavity Insulation by County 2012

Yearly Average Water Heater Energy Factor Distribution for 2012

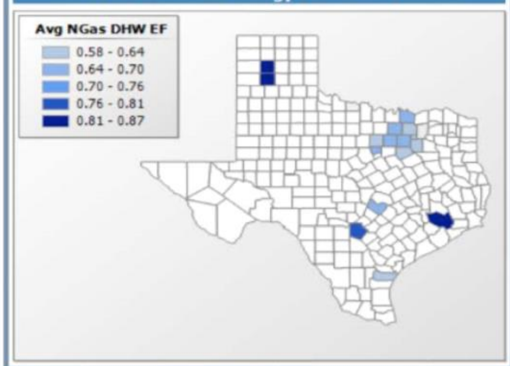
Overall Data Statistics derived from a subset of Counties having house count > 10

	Total Count	Average NGas EF	Standard Deviation
Single Family	4242	0.90	0.05
Multi Family	73	0.85	0.11

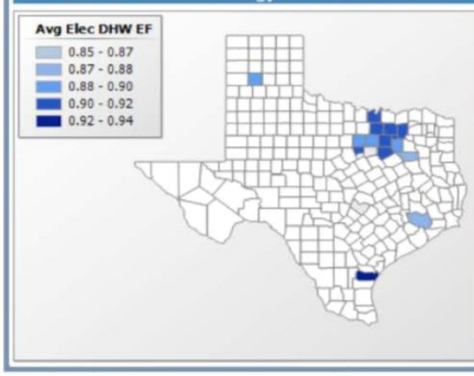
	Total Count	Average Elec EF	Standard Deviation
Single Family	8429	0.67	0.12
Multi Family	190	0.93	0.03

Single Family

NGas Water Heater Energy Factor Distribution



Elec Water Heater Energy Factor Distribution



County	Avg NGas WH EF	House Count
Wichita	0.87	19
Potter	0.87	49
Randall	0.83	95
Harris	0.83	529
Fort bend	0.82	28
Bexar	0.78	76
Dallas	0.69	1675
Travis	0.69	150
Hood	0.68	15
Grayson	0.68	23
Tarrant	0.66	1459
Denton	0.66	1187
Collin	0.62	2271
Parker	0.62	23
Rockwall	0.61	399
Ellis	0.60	133
Nueces	0.58	92
Kaufman	0.58	145
Hunt	0.58	21

County	Avg Elec WH EF	House Count
Travis	0.94	37
San patricio	0.93	24
Nueces	0.93	28
Hood	0.92	23
Cooke	0.92	26
Hunt	0.91	43
Rockwall	0.91	76
Denton	0.91	731
Ellis	0.91	104
Dallas	0.90	544
Collin	0.90	418
Parker	0.90	36
Tarrant	0.90	1788
Randall	0.89	206
Kaufman	0.89	45
Harris	0.88	11
Henderson	0.88	15
Johnson	0.85	59

Figure 16: Average Water Heater Efficiencies 2012

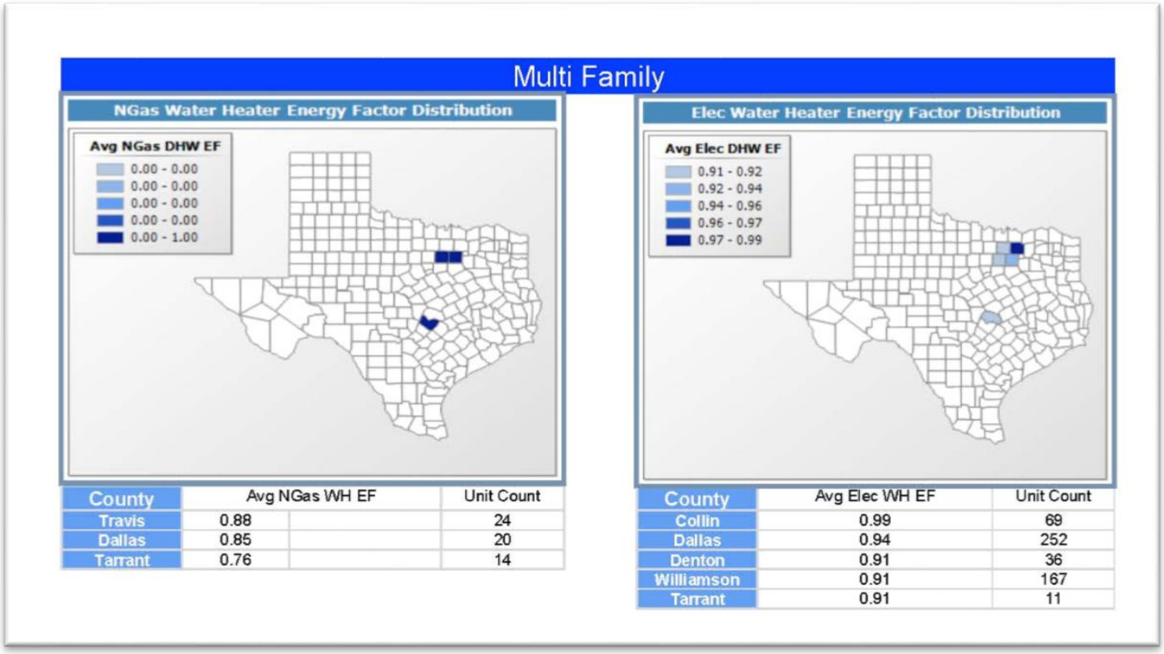


Figure 16: Average Water heater Efficiencies 2012 (continued)

This report shows both natural gas and electric water heater efficiencies across Texas in 2012.

Average Window to Wall Area Ratio across Counties for 2012

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	11.46	3.68
Multi Family	15.18	6.71

Single Family

County	Avg Window To Wall Area	House Count
Henderson	13.65	19
Ellis	12.88	226
Travis	12.67	187
Fort bend	12.13	28
San patricio	12.11	24
Rockwall	11.98	474
Denton	11.85	1918
Dallas	11.75	2230
Tarrant	11.56	3247
Johnson	11.55	68
Kaufman	11.55	190
Grayson	11.46	24
Collin	11.26	2689
Nueces	11.20	120
Hood	11.08	38
Bexar	11.05	78
Cooke	10.73	28
Parker	10.58	59
Potter	10.42	55
Harris	10.15	539
Hunt	9.32	64
Randall	8.37	301
Wichita	7.90	29

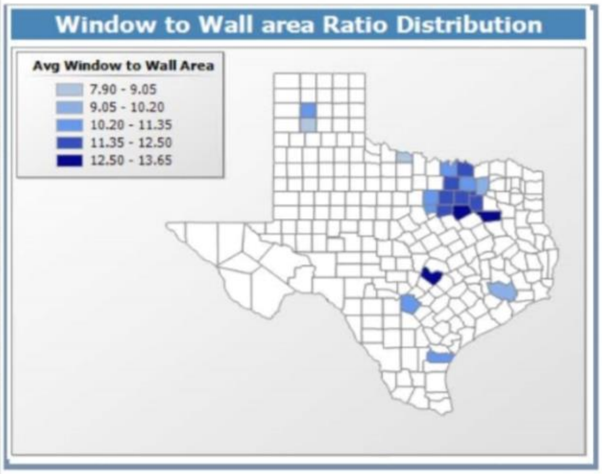


Figure 17: Average Window to Wall Ratio 2012

Multi Family

County	Avg Window To Wall Area	Unit Count
Dallas	17.45	26
Tarrant	13.37	14
Williamson	12.59	13

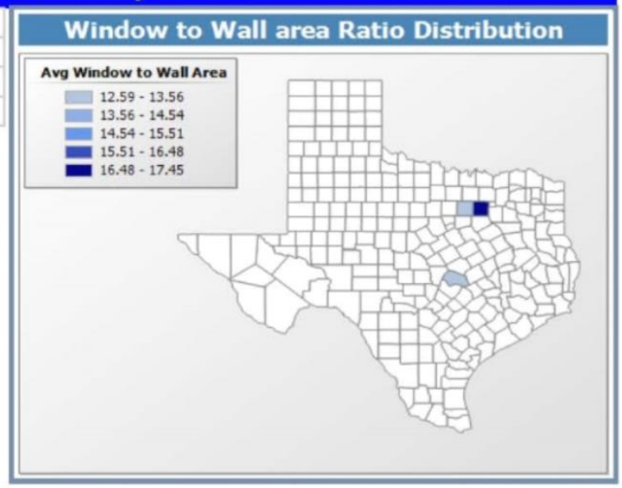


Figure 17: Average Window to Wall Ratio 2012 (continued)

Here is an analysis of the window to wall ratio across Texas in 2012.
The formula used is: 100 * <total window area sq. ft.> / <total wall area sq. ft.>

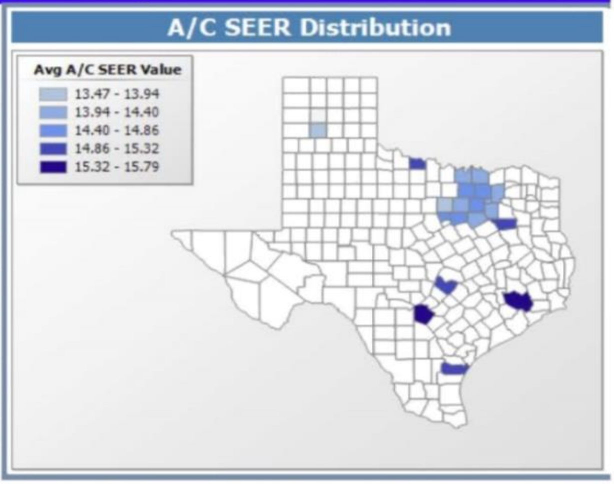
Average A/C SEER across Counties for 2012

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	14.55	1.09
Multi Family	13.28	0.61

Single Family

County	Avg SEER Value	House Count
Fort bend	15.79	28
Bexar	15.63	78
Harris	15.54	540
Travis	15.15	187
San patricio	15.06	24
Nueces	15.04	120
Wichita	15.00	29
Henderson	14.95	19
Johnson	14.70	68
Dallas	14.67	2230
Hood	14.61	38
Collin	14.60	2689
Denton	14.58	1918
Tarrant	14.39	3247
Ellis	14.35	226
Cooke	14.18	28
Grayson	14.17	24
Rockwall	14.14	474
Hunt	14.06	64
Kaufman	14.02	190
Parker	13.75	59
Randall	13.59	301
Potter	13.47	55



Multi Family

County	Avg SEER Value	Unit Count
Tarrant	14.56	25
Dallas	13.31	272
Williamson	13.05	175

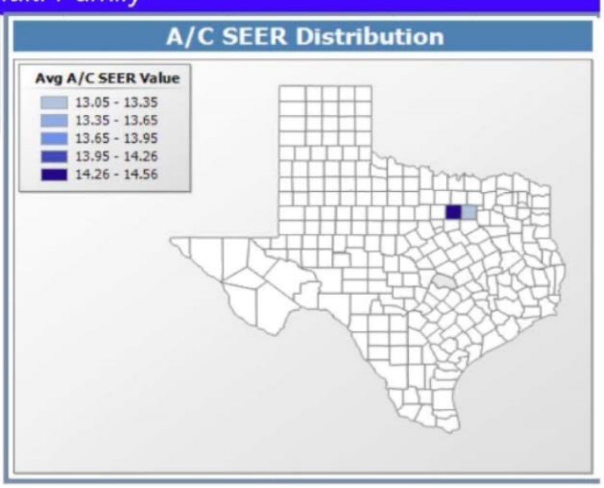


Figure 18: Average SEER 2012

The efficiency (and sizing) of air conditioning is a vital component of energy efficiency in Texas.

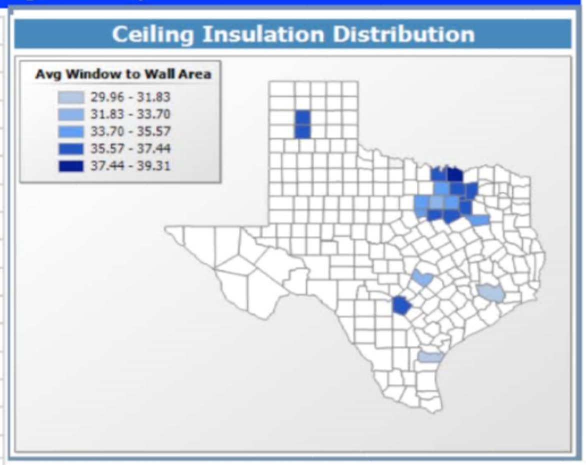
Average Ceiling Insulation across Counties for 2012

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	34.31	5.35
Multi Family	40.28	7.89

Single Family

County	Avg Ceiling Insulation	House Count
Wichita	39.31	29
Grayson	38.29	24
Randall	37.34	301
Potter	37.18	55
Bexar	37.06	78
Cooke	36.93	28
Ellis	36.46	237
Rockwall	36.37	475
Hunt	36.34	64
Collin	36.34	2689
Kaufman	36.28	190
Fort bend	36.14	28
Johnson	35.79	68
Hood	35.47	38
Henderson	34.74	19
Denton	34.46	1918
Dallas	33.93	2219
Parker	33.82	59
Travis	32.85	187
Tarrant	32.65	3247
Nueces	30.00	120
San patricio	30.00	24
Harris	29.96	540



Multi Family

County	Avg Ceiling Insulation	House Count
Dallas	43.04	272
Williamson	37.52	175
Tarrant	35.33	25

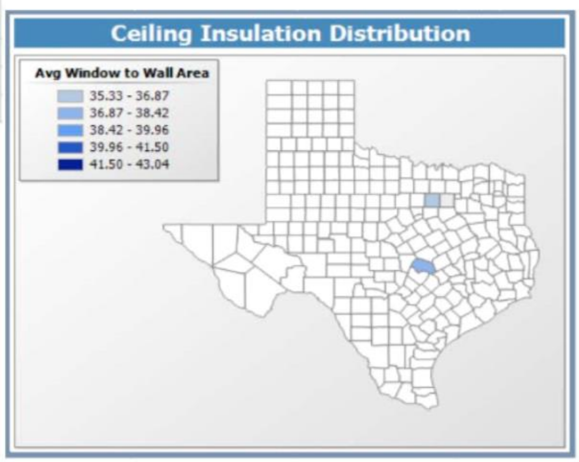


Figure 19: Average Ceiling Insulation 2012

Average Heating Efficiency across Counties for 2012

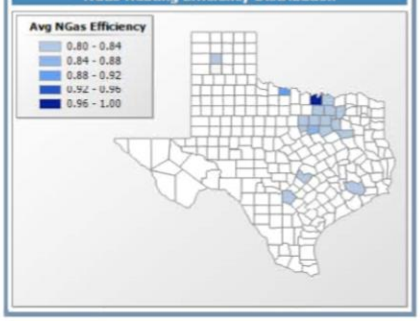
Overall Data Statistics derived from a subset of Counties having house count > 10

	Total Count	Average NGas Efficiency	Standard Deviation
Single Family	8173	0.81	0.04
Multi Family	44	0.82	0.05

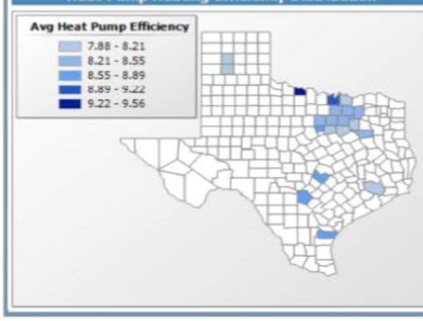
	Total Count	Average Heat Pump Efficiency	Standard Deviation
Single Family	4445	8.37	0.67
Multi Family	428	7.81	0.42

Single Family

NGas Heating Efficiency Distribution



Heat Pump Heating Efficiency Distribution

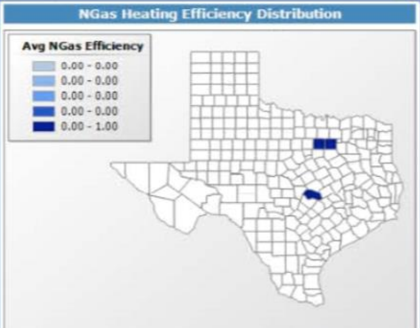


County	Avg NGas Heating Efficiency	House Count
Cooke	1.00	1
Wichita	0.88	19
Hood	0.84	15
Parker	0.82	14
Fort bend	0.82	28
Harris	0.81	526
Tarrant	0.81	1419
Dallas	0.81	1586
Denton	0.81	1211
Travis	0.81	124
Potter	0.81	28
Collin	0.80	2327
Bexar	0.80	76
Rockwall	0.80	406
Ellis	0.80	137
Hunt	0.80	21
Henderson	0.80	4
Kaufman	0.80	147
Grayson	0.80	22
Randall	0.80	57

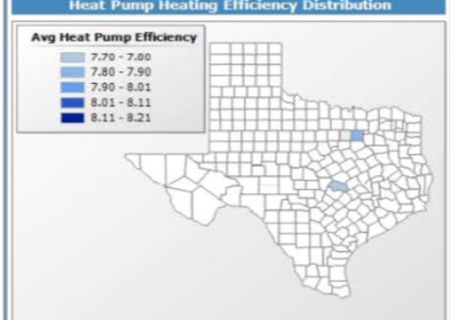
County	Avg Heat Pump Heating Efficiency	House Count
Wichita	9.56	10
Cooke	9.13	26
Nueces	8.69	120
San patricio	8.66	24
Travis	8.62	63
Bexar	8.60	2
Rockwall	8.47	66
Hunt	8.47	43
Dallas	8.46	628
Denton	8.42	706
Tarrant	8.36	1825
Collin	8.36	360
Henderson	8.35	15
Parker	8.23	45
Johnson	8.13	63
Kaufman	8.11	43
Ellis	8.10	99
Grayson	8.10	2
Potter	8.08	27
Harris	8.02	11
Randall	7.88	244

Multi Family

NGas Heating Efficiency Distribution



Heat Pump Heating Efficiency Distribution



County	Avg NGas Heating Efficiency	Unit Count
Dallas	0.85	20
Williamson	0.81	8
Tarrant	0.80	16

County	Avg Heat Pump Heating Efficiency	Unit Count
Tarrant	8.21	9
Dallas	7.86	252
Williamson	7.70	167

Figure 20: Average Heating Efficiency 2012

Here we examine space heating efficiency in 2012 using both natural gas and heap pump heating.

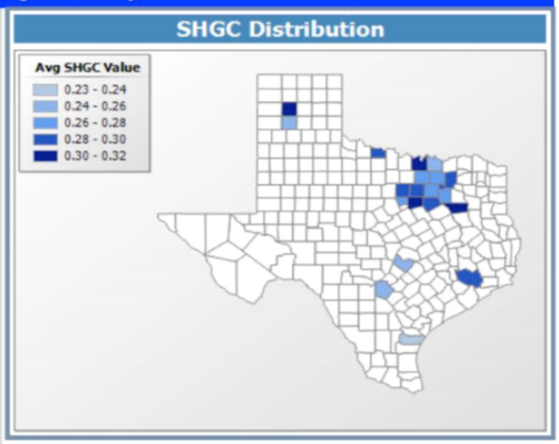
Average SHGC across Counties for 2012

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	0.28	0.05
Multi Family	0.27	0.03

Single Family

County	Avg SHGC Value	House Count
Henderson	0.32	19
Johnson	0.31	68
Cooke	0.30	28
Potter	0.30	55
Hunt	0.30	64
Wichita	0.30	29
Tarrant	0.29	3247
Rockwall	0.29	475
Ellis	0.28	237
Harris	0.28	540
Parker	0.28	59
Denton	0.28	1918
Dallas	0.28	2219
Kaufman	0.27	190
Collin	0.27	2689
Hood	0.27	38
Travis	0.26	187
Grayson	0.26	24
Randall	0.25	301
Bexar	0.25	78
Nueces	0.23	120
San patricio	0.23	24
Fort bend	0.23	28



Multi Family

County	Avg SHGC Value	Unit Count
Williamson	0.30	175
Tarrant	0.27	25
Dallas	0.26	272

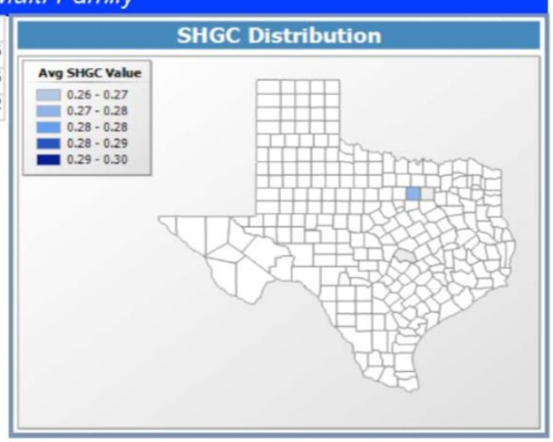


Figure 21: Average SHGC 2012

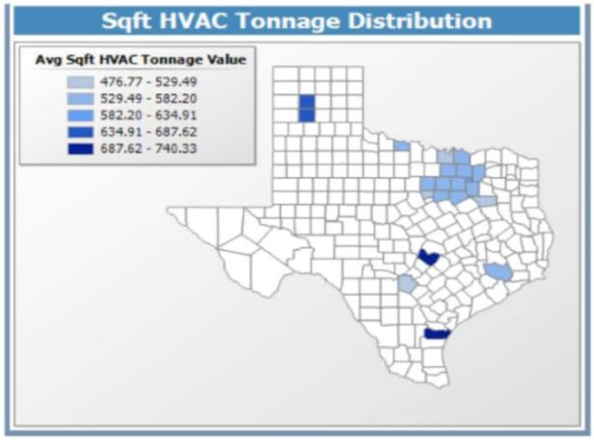
Average HVAC across Counties for 2012

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	564.96	133.97
Multi Family	683.25	283.37

Single Family

County	Avg Sqft Tonnage Value	House Count
San Patricio	740.33	24
Travis	721.15	187
Nueces	719.03	120
Potter	679.54	55
Randall	646.25	301
Rockwall	587.40	475
Wichita	575.71	29
Harris	566.71	540
Tarrant	566.15	3247
Collin	562.84	2689
Denton	559.77	1918
Hunt	557.31	64
Grayson	556.06	24
Johnson	551.91	68
Kaufman	551.30	190
Ellis	547.22	237
Parker	541.45	59
Dallas	537.52	2219
Bexar	520.14	78
Henderson	511.56	19
Hood	487.85	38
Cooke	483.20	28
Fort bend	476.77	28



Multi Family

County	Avg Sqft Tonnage Value	Unit Count
Dallas	758.44	26
Tarrant	654.29	14
Williamson	564.06	13

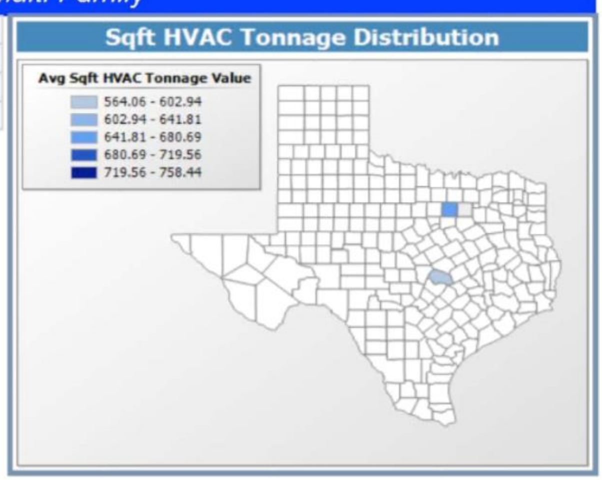


Figure 22: Average HVAC Tonnage to Sq Ft 2012

Another way to evaluate high performing houses is how much air conditioning they have per sq. ft. of house. Here we see ranges, for single family homes, of 475 to 741 sq. ft. per ton with an average of 565 sq. ft. per ton. Last year's average was 558 sq. ft. per ton. Thus, Texas is becoming more efficient.

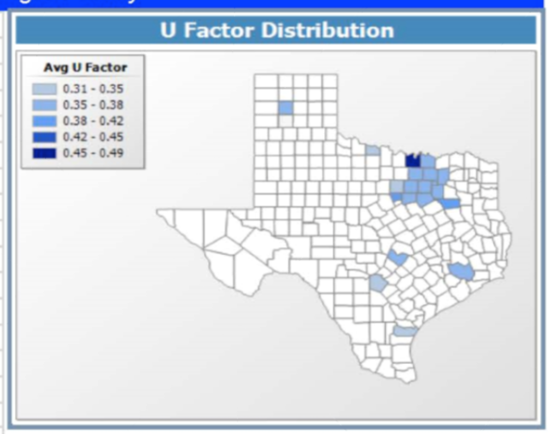
Average U Factor across Counties for 2012

Overall data Statistics derived from a subset of Counties having house count > 10

	Average	Standard Deviation
Single Family	0.36	0.06
Multi Family	0.38	0.04

Single Family

County	Avg U Factor	House Count
Cooke	0.49	28
Henderson	0.39	19
Hood	0.39	38
Travis	0.38	187
Kaufman	0.37	190
Hunt	0.37	64
Potter	0.37	55
Tarrant	0.37	3247
Rockwall	0.37	475
Dallas	0.36	2219
Harris	0.36	540
Ellis	0.36	237
Denton	0.35	1918
Grayson	0.35	24
Johnson	0.35	68
Collin	0.35	2689
Parker	0.34	59
Bexar	0.33	78
Wichita	0.32	29
Nueces	0.32	120
San patricio	0.32	24
Fort bend	0.32	28
Randall	0.31	301



Multi Family

County	Avg U Factor	Unit Count
Williamson	0.40	175
Dallas	0.36	272
Tarrant	0.36	25

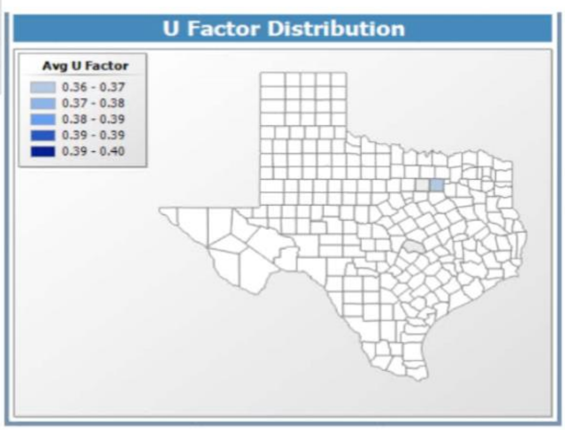


Figure 23: Average U Factor 2012

The U Factor applies to the heat transfer of a window caused by temperature, no direct solar radiation.

1.9 Code Adoption

One of the TERP's energy efficiency programs to reduce emissions from stationary sources was the establishment of the Texas Building Energy Performance Standards (TBEPS) that define the building energy codes for all new residential and commercial construction statewide. The original TBEPS were based on the energy efficiency chapter of the 2000 International Residential Code (IRC), including the 2001 Supplement, for single-family residences, (i.e., one- and two-family residences of three stories or less above grade) and the 2000 International Energy Conservation Code (IECC), including the 2001 Supplement, for commercial, industrial and residential buildings over three stories.

Over the years since the establishment of the TERP, newer editions of the IRC and the IECC have been published. The Energy Systems Laboratory was mandated to review the stringency of the new code editions and provide recommendations to the State on whether to upgrade the TBEPS to the new editions. In the time frame of 2002-2009, with the laboratory's recommendations and additional input from stakeholder meetings and public comment periods, the State of Texas did not adopt any of the newer editions of the energy efficiency codes as the TBEPS. During this timeframe, several individual jurisdictions did adopt the newer editions of the IRC and the IECC.

With the laboratory's recommendation, on April 1, 2011, SECO updated the TBEPS commercial and residential (excluding single-family) energy codes to the 2009 International Energy Conservation Code (IECC). On January 1, 2012, the TBEPS for single-family residential was updated to Chapter 11 (Energy Efficiency) of the 2009 International Residential Code (IRC).

In July 2011, the Laboratory began the stringency review of the newly published 2012 IRC and IECC. In December 2011, the Laboratory provided the findings of the technical analysis of stringency to SECO, indicating that both the residential and the commercial provisions of the 2012 code are more stringent than the TBEPS, which are based on the 2009 code. In 2012, in accordance with the Health and Safety Code Section 388.003, as amended, the Laboratory reviewed and considered all 1,526 comments collected by SECO from both the individuals and the large constituencies during the public comment period. In July, 2012, the Laboratory held a stakeholders meeting in which the Laboratory presented the stringency analysis and findings and reviewed the public comments consideration and analysis. In August 2012 the Laboratory provided SECO with a final recommendation and analysis regarding the stringency and environmental impact of Chapter 11, 2012 IRC and the 2012 IECC versus the current TBEPS, based on Chapter 11 of the 2009 IRC and the 2009 IECC. The Laboratory recommended SECO to adopt Chapter 11 of the 2012 IRC, as published, as the state-mandated energy code for all residential construction, one- and two-family residences of three stories or less above grade, and to adopt the 2012 IECC, as published, for commercial, industrial and residential buildings over three stories.

As of the time of this report, SECO has not adopted the 2012 code.

Table 4: Code adoptions

CITY NAME	Commercial Building Code (IBC)	Residential Building Code (IRC)	Energy Code (IECC)	Electrical Code (NEC)	Mechanical Code (IMC)	Plumbing Code (IPC)	Green Building Code	Existing Building Code (IEBC)	Other Codes
Abilene	2003	2003	2000	2008	2003	2003	N/A	2003	2003 IFGC
Addison									
Allen									
Amarillo	2006	2006	2006	2008	2006	2006	N/A	2006	2006 IFC, 2006 IFGC
Angleton									
Arlington	2003	2003	2003	2002	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC
Austin									
Baytown	2006	2006	2006	2008	2006	2006	N/A	2006	N/A
Beaumont									
Bedford									
Big Spring	2006	2006	2006	2005	2006	2006	N/A	2006	N/A
Borger									
Brownsville	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC
Bryan	2003	2003	2003	2002	2003	2003	N/A	2003	2003 IFGC
Burleson	2006	2006	2006	2005	2006	2006	N/A	N/A	North Central Texas Council of Government Amendment
Carrollton *	2006	2006	2006	2008	2006	2006	N/A	N/A	NCTCOG Recommended Regional Amendments
Cedar Hill	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC
Cedar Park	2009	2009	2009	2008	2009	2009	N/A	2009	2006 IFC with Ammendments, 2009 IPMC
Cleburne	2003	2003	2003	2002	2003	2003	N/A	N/A	N/A
College Station	2009	2009	2009	2008	2009	2009	N/A	N/A	N/A
Conroe	2003	N/A	N/A	2008	2003	2003	N/A	N/A	2003 IFC
Coppell	N/A	2006	2006	2005	2006	2006	N/A	2006	2006 IFC, 2006 IFGC, 2006 IPMC
Copperas Cove									
Corpus Christi	2003	2003	2003	2002	2003	2003	N/A	N/A	N/A
Corsicana	2009	2009	N/A	2008	2009	2009	N/A	N/A	N/A
Dallas	2006	2006	2006	2008	2006	2006	City of Dallas Ordinance #881070	2003	2006 IFC, 2006 IFGC
Deer Park									
Del Rio									
Denton									
Desoto	2003	2003	2003	2002	2003	2003	N/A	N/A	N/A
Devine									
Duncanville	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC, 2006 IPMC
Eagle Pass	2009	2009	2009	2008	2006	2009	N/A	2006	N/A
Edinburg									
El Paso									
Euless	2003	2003	2003	2002	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC, 2003 IPMC
Farmers Branch									
Flower Mound									
Fort Worth	2003	2003	2003	2008	2003	2003	N/A	N/A	2003 IFGC
Friendswood	2009	2009	2009	2008	2009	2009	N/A	N/A	N/A
Frisco									
Galveston	2009	2009	2009	2008	2009	2009	N/A	N/A	2009 IFC, 2009 IPMC
Garland	2003	2003	2003	2005	2003	2003	N/A	N/A	N/A
Georgetown	2003	2003	2003	2002	2003	2003	N/A	2003	N/A
Grand Prairie	2003	2003	2003	2005	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC
Grapevine	2006	2006	[illegible]	2005	2006	2006	N/A	2006	N/A
Greenville	2006	2006	2006	2005	2006	2006	N/A	2006	N/A
Haltom City	2003	2003	2003	2002	2003	2003	N/A	N/A	N/A
Harker Heights	2009	2009	2008	2008	2009	2009	N/A	2006	2009 IFC, 2009 IFGC
Harlingen									
Houston									
Huntsville	2003	2003	2003	2005	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC, 2003 IPMC
Hurst	2003	2003	2003	2005	2003	2003	N/A	N/A	2003 IPMC
Irving	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFC, 2006 IFGC
Keller	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC
Killeen									
Kingsville									
Kyle	2000	2000	2000	1999	2000	2000	N/A	N/A	2000 IPMC
La Porte									
Lake Jackson									
Lancaster	2003	2003	2003	2002	2003	2003	N/A	N/A	2003 IPMC

Table 4: Code adoptions (continued)

CITY NAME	Commercial Building Code (IBC)	Residential Building Code (IRC)	Energy Code (IECC)	Electrical Code (NEC)	Mechanical Code (IMC)	Plumbing Code (IPC)	Green Building Code	Existing Building Code (IEBC)	Other Codes
Desoto	2003	2003	2003	2002	2003	2003	N/A	N/A	N/A
Devine									
Duncanville	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC, 2006 IPMC
Eagle Pass	2009	2009	2009	2008	2006	2009	N/A	2006	N/A
Edinburg									
El Paso									
Euless	2003	2003	2003	2002	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC, 2003 IPMC
Farmers Branch									
Flower Mound									
Fort Worth	2003	2003	2003	2008	2003	2003	N/A	N/A	2003 IFGC
Friendswood	2009	2009	2009	2008	2009	2009	N/A	N/A	N/A
Frisco									
Galveston	2009	2009	2009	2008	2009	2009	N/A	N/A	2009 IFC, 2009 IPMC
Garland	2003	2003	2003	2005	2003	2003	N/A	N/A	N/A
Georgetown	2003	2003	2003	2002	2003	2003	N/A	2003	N/A
Grand Prairie	2003	2003	2003	2005	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC
Grapevine	2006	2006	[illegible]	2005	2006	2006	N/A	2006	N/A
Greenville	2006	2006	2006	2005	2006	2006	N/A	2006	N/A
Haltom City	2003	2003	2003	2002	2003	2003	N/A	N/A	N/A
Harker Heights	2009	2009	2009	2008	2009	2009	N/A	2006	2009 IFC, 2009 IFGC
Harlingen									
Houston									
Huntsville	2003	2003	2003	2005	2003	2003	N/A	N/A	2003 IFC, 2003 IFGC, 2003 IPMC
Hurst	2003	2003	2003	2005	2003	2003	N/A	N/A	2003 IPMC
Irving	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFC, 2006 IFGC
Keller	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC
Killeen									
Kingsville									
Kyle	2000	2000	2000	1999	2000	2000	N/A	N/A	2000 IPMC
La Porte									
Lake Jackson									
Lancaster	2003	2003	2003	2002	2003	2003	N/A	N/A	2003 IPMC
San Antonio									
San Benito	2009	2009	2009	N/A	2009	2009	N/A	N/A	2009 IFGC, 2009 IPMC, 2009 IWUIC
San Juan	2006	2006	2006	2008	2006	2006	N/A	2006	2006 IFC/Hurricane Resistant Residential Construction
San Marcos									
Schertz									
Seguin	2006	2006	2006	2008	2006	2006	N/A	2006	N/A
Sherman	2006	2006	2006	2005	2006	2006	N/A	N/A	N/A
Socorro	2003	2003	2003	2003	2003	2003	2003	2003	N/A
Southlake	2006	2006	2006	2008	2006	2006	N/A	N/A	N/A
Sugar Land	2003	2003	2003	2005	2003	2003	N/A	2003	2003 IFC, 2003 IFGC, 2003 IPMC
Temple	2006	2006	2006	2008	2006	2006	N/A	N/A	2006 IFGC, 2006 IPMC
Texarkana									
Texas City	2006	2006	2006	2006	2006	2006	2006	2006	N/A
The Colony	2006	2006	2006	2008	2006	2006	N/A	N/A	N/A
Tyler									
Victoria									
Waco *	2009	2009	2009	2008	2009	2009	N/A	2009	2009 IFC, 2009 IFGC, 2009 IPMC
Waxahachie									
Weatherford									
Weslaco									
Wichita Falls	2006	2006	2006	2008	2006	2006	N/A	2006	N/A

Section 388.009 of HB 3235 requires the Laboratory to develop and administer a state-wide training program for municipal building inspectors who seek to become code-certified inspectors. To accomplish this, the Laboratory originally developed the Energy Code Workshops which were based on the 2006 International Energy Conservation Code (IECC) as published by the International Code Council (ICC) for residential and commercial buildings, with amendments. Since then, the Laboratory has updated the workshops to the 2009 IECC, and developed preliminary versions of 2012 code workshops. During 2012, the Laboratory provided and was involved in various energy-code-related trainings. These included:

- 2009 IECC Commercial Provisions Training;

- 2009 IECC Residential Provisions Training;
- 2009 IECC Fundamentals for Commercial Provisions Training; and
- 2009 IECC Fundamentals for Residential Provisions Training.
- Common Sense Construction Using the Energy Code
- 2012 IECC
- ASHRAE Standard 90.1-2010
- ASHRAE Standard 90.1-2010. Online Training Part I: Overview
- ASHRAE Standard 90.1-2010. Online Training Part II: Envelope Provisions
- ASHRAE Standard 90.1-2010. Online Training Part III: HVAC Provisions
- ASHRAE Standard 90.1-2010. Online Training Part IV: Mechanical Provisions
- ASHRAE Standard 90.1-2010. Online Training Part V: Lighting Provisions

Additional workshops included

- New Funding Alternatives, Sources and Strategies to Create High-Performing, Energy Efficient Buildings
- Which Green Rating System is Right for You?
- Energy Management for Schools
- Insulation Strategies & Coated Foam Roofing Systems
- Energy Efficiency Changes &Local Above Code Programs
- Pathway to Net Zero Homes & Innovations in PV
- High Performance Homes & Selling High Performance Homes
- Diagnostic Tools & Lighting Technologies
- Commercial Buildings - Evaluation Opportunities & HVAC Economizers
- A Methodology for Calculating Integrated NOx Emissions Reductions From Energy Efficiency And Renewable Energy (EE/RE) Programs Across State Agencies In Texas. Online Webinar.

In July 2011, the Laboratory was awarded a grant from the State Energy Conservation Office to conduct ASHRAE Standard 90.1-2010 Workshops across the State of Texas (ARRA funded). The project continued through March 31, 2012. The primary goal of this project was to help train and fully familiarize the State agency staff, code enforcement personnel, engineers and architects with the content of this newly adopted standard in order to effectively implement the provisions of the ASHRAE 90.1-2010 in Texas. Participants of this workshop examined the latest ASHRAE energy efficiency standards for commercial buildings, were able to identify and compare the substantive changes/additions made since the 2007 ASHRAE edition, were equipped to evaluate the mandatory and prescriptive HVAC, envelope, service water heating, and lighting criteria and to identify applicable IRS energy tax credits and Code Compliance Software when applying the Standards. Overall, a total of nine (9) full-day workshop sessions were conducted, to a total of 340 participants. With the success of the program, the workshop was re-edited for videotaping purposes, and the video filming and production were completed successfully. The online sessions are available on SECO's website at: http://seco.cpa.state.tx.us/tbec/videos.php.

The Laboratory collaborated with the South-central Partnership for Energy Efficiency as a Resource (SPEER) to provide other educational workshops on strategies to advance high performance homes and buildings. The project, funded by SECO, began in May 2012 and continued into 2013. By December 2012, three (3) different types of workshops were developed and ten (10) total six-hour workshops have been delivered by the SPEER to a total of 534 participants.

In addition, the Laboratory provided 2009 code trainings at the two BPI annual conferences, and a 2012 code training in El Paso.

The total number of workshops held by the Energy Systems Laboratory for the year 2012 was 31 with 957 participants, and over 510 additional participants in the online training sessions.

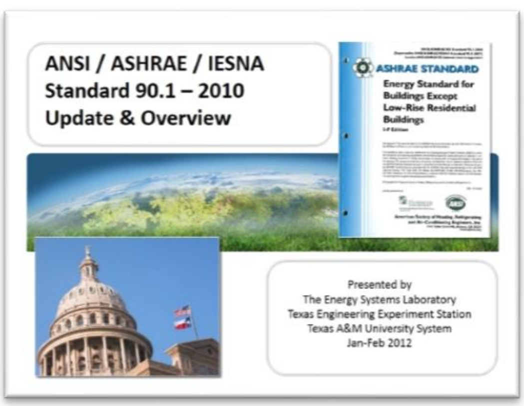
Table 4: List of all short courses/workshops conducted in 2012

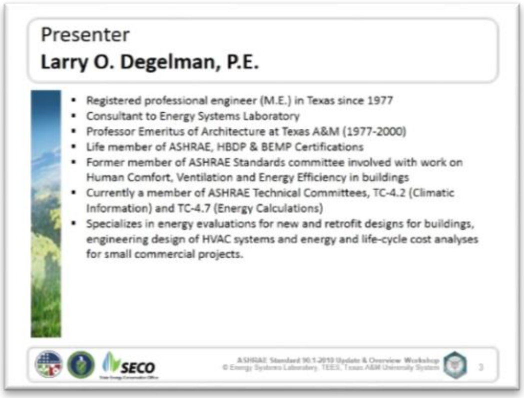
Short Courses/Workshops				
Course Title	**Description**	**Date**	**Location**	**Attendance**
2009 IECC – Commercial Provisions	Full Day training	2/1/2012	Houston, TX (12th Annual Building Professional Institute)	25
2009 IECC – Residential Provisions	Full Day training	2/1/2012	Houston, TX (12th Annual Building Professional Institute)	18
ASHRAE Standard 90.0-2010	Full day training	2/3/2012	Corpus Christi, TX	50
ASHRAE Standard 90.0-2010	Full day training	2/15/2012	Houston, TX	25
2009 IECC Commercial Provisions	Full day training	5/21/2012	Arlington, TX (20th Annual Building professional Institute)	25
2009 IECC Residential Provisions	Full day training	5/22/2012	Arlington, TX (20th Annual Building professional Institute)	40
Common Sense Construction Using the Energy Code	Full day training	5/23/2012	Arlington, TX (20th Annual Building professional Institute)	32
Insulation Strategies & Coated Foam Roofing Systems	3 Hour Workshop	9/17/2012	Austin, TX	21
Energy Efficiency Changes & Local Above Code Programs	3 Hour Workshop	9/17/2012	Austin, TX	34
Insulation Strategies & Coated Foam Roofing Systems	3 Hour Workshop	9/18/2012	DFW, TX	20
Energy Efficiency Changes & Local Above Code Programs	3 Hour Workshop	9/18/2012	DFW, TX	30
Insulation Strategies & Coated Foam Roofing Systems	3 Hour Workshop	9/20/2012	San Antonio, TX	22
Energy Efficiency Changes & Local Above Code Programs	3 Hour Workshop	9/20/2012	San Antonio, TX	29
Insulation Strategies & Coated Foam Roofing Systems	3 Hour Workshop	9/21/2012	Houston, TX	37
Energy Efficiency Changes & Local Above Code Programs	3 Hour Workshop	9/21/2012	Houston, TX	36
2012 IECC	6 Hour Workshop	9/21/2012	El Paso, TX	49

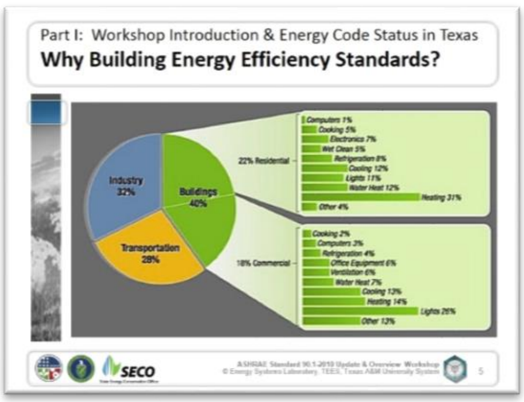
New Funding Alternatives, Sources and Strategies to Create High-Performing, Energy Efficient Buildings	2 Hour Workshop	10/9/2012	Galveston, TX	**65**
Which Green Rating System is Right for You?	4 Hour Workshop	10/9/2012	Galveston, TX	**55**
Energy Management for Schools	4 Hour Workshop	10/9/2012	Galveston, TX	**39**
Pathway to Net Zero Homes & Innovations in PV	3 Hour Workshop	10/23/2012	Austin, TX	26
High Performance Homes & Selling High Performance Homes	3 Hour Workshop	10/23/2012	Austin, TX	24
Pathway to Net Zero Homes & Innovations in PV	3 Hour Workshop	10/24/2012	San Antonio, TX	11
High Performance Homes & Selling High Performance Homes	3 Hour Workshop	10/24/2012	San Antonio, TX	9
Diagnostic Tools & Lighting Technologies	3 Hour Workshop	12/5/2012	San Antonio, TX	19
Commercial Bldg - Evaluation Opportunities & HVAC Economizers	3 Hour Workshop	12/5/2012	San Antonio, TX	18
Diagnostic Tools & Lighting Technologies	3 Hour Workshop	12/6/2012	Houston, TX	33
Commercial Bldg - Evaluation Opportunities & HVAC Economizers	3 Hour Workshop	12/6/2012	Houston, TX	33
Diagnostic Tools & Lighting Technologies	3 Hour Workshop	12/7/2012	Austin, TX	26
Commercial Bldg - Evaluation Opportunities & HVAC Economizers	3 Hour Workshop	12/7/2012	Austin, TX	24
Diagnostic Tools & Lighting Technologies	3 Hour Workshop	12/11/2012	Dallas, TX	46
Commercial Bldg - Evaluation Opportunities & HVAC Economizers	3 Hour Workshop	12/11/2012	Dallas, TX	36
Total of 31 workshops				**957**
ASHRAE Standard 90.0-2010. Part I: Overview	34 minutes online training video	Available since April 2012	Online, uploaded by the Texas State Energy Conservation Office (SECO)	183
ASHRAE Standard 90.0-2010. Part II: Envelope Provisions	42 minutes online training video	Available since April 2012	Online, uploaded by SECO	113
ASHRAE Standard 90.0-2010. Part III: HVAC Provisions	19 minutes online training video	Available since April 2012	Online, uploaded by SECO	80
ASHRAE Standard 90.0-2010. Part IV: Mechanical Provisions	31 minutes online training video	Available since April 2012	Online, uploaded by SECO	45
ASHRAE Standard 90.0-2010. Part V: Lighting Provisions	28 minutes online training video	Available since April 2012	Online, uploaded by SECO	89

A Methodology for Calculating Integrated NOx Emissions Reductions From Energy Efficiency And Renewable Energy (EE/RE) Programs Across State Agencies In Texas	1.5 hours webinar	8/8/2012	Online, sponsored by The State Energy Efficiency Action Network (SEE Action), U.S. EPA State Climate & Energy Program	unknown
Total of 6 online training sessions				**510+**
Total Trainees				**1,467+**

Slides from the ASHRAE 90.1 Standard Update Workshops which were presented all in six different locations in the State of Texas in 2012







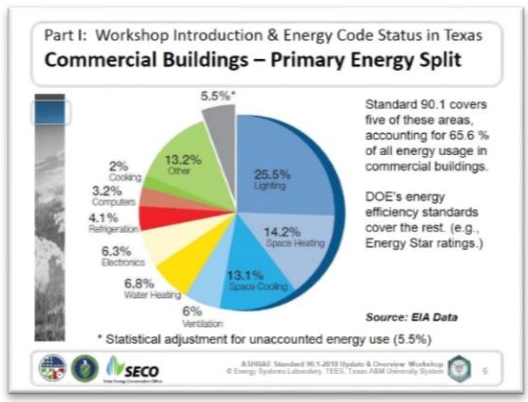
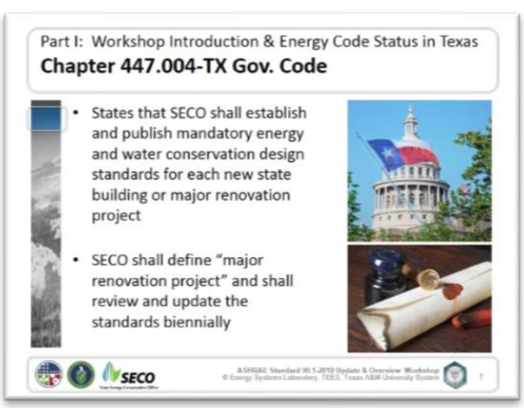
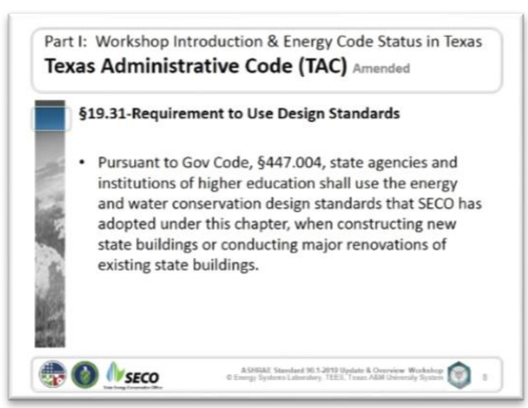
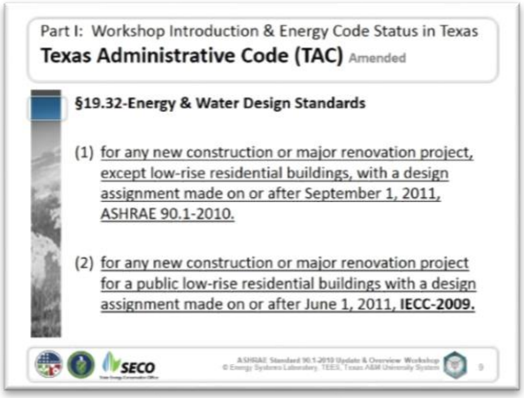
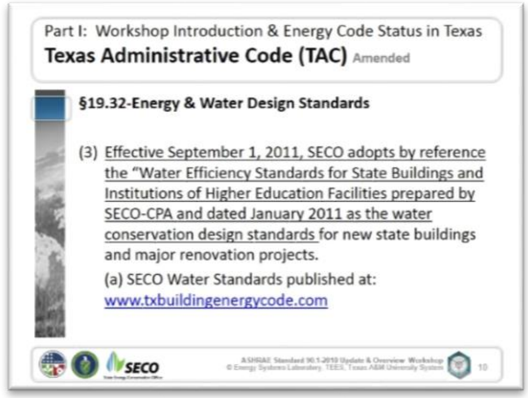


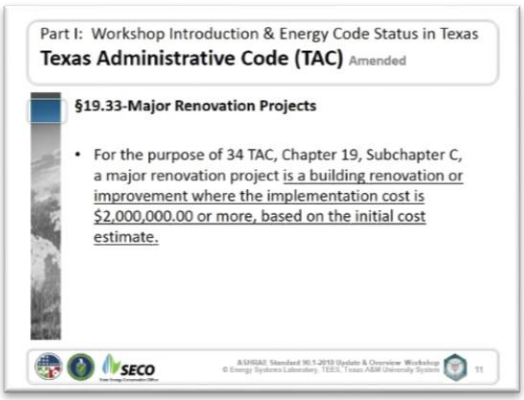
Figure 24: ASHRAE 90.1 Standard Update Workshop











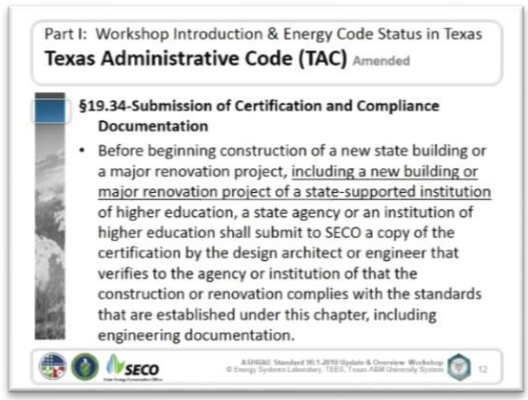
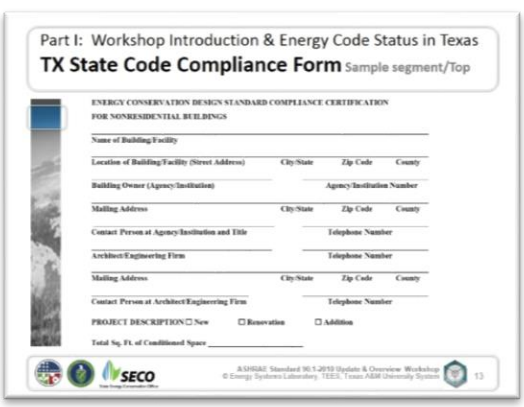
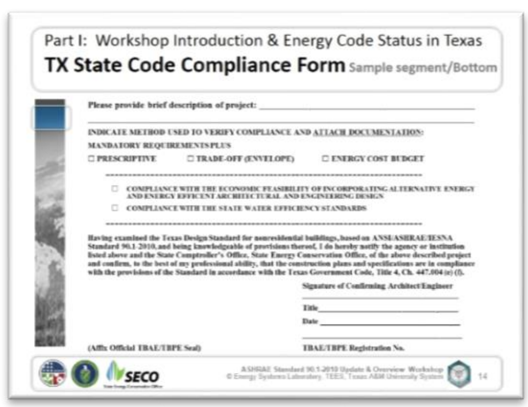
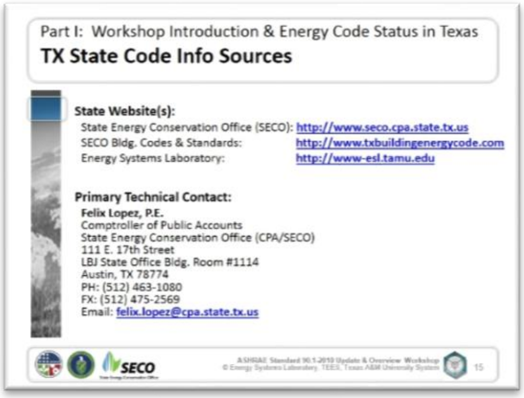
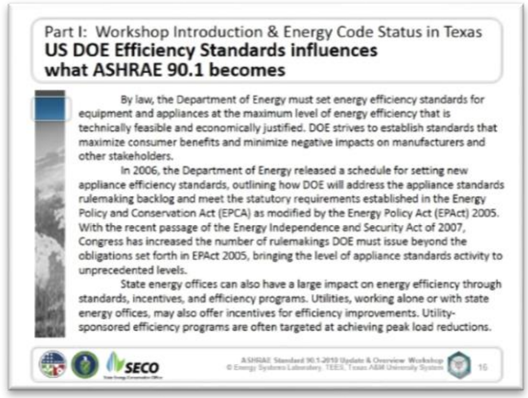


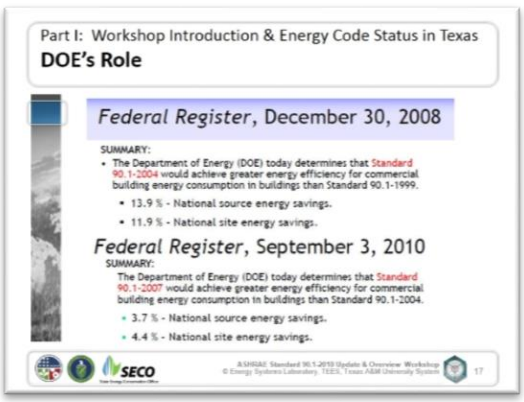
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











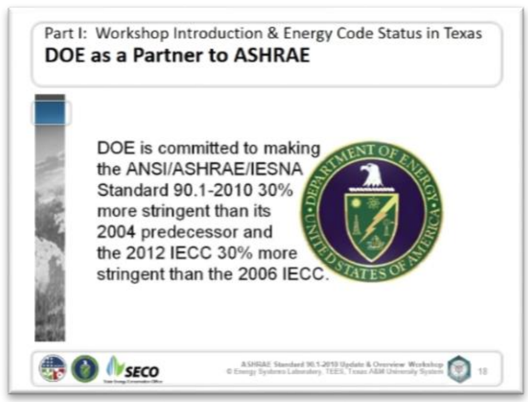
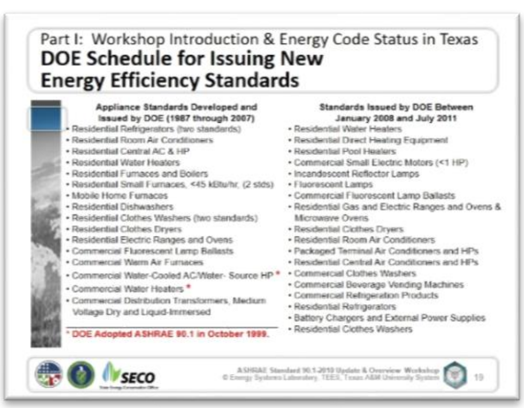
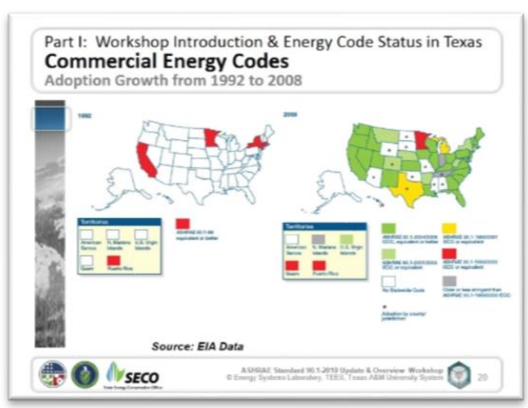
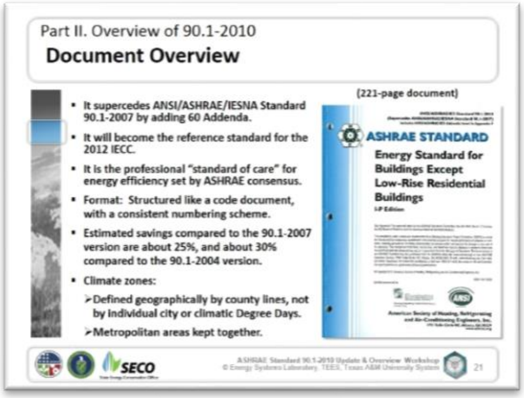
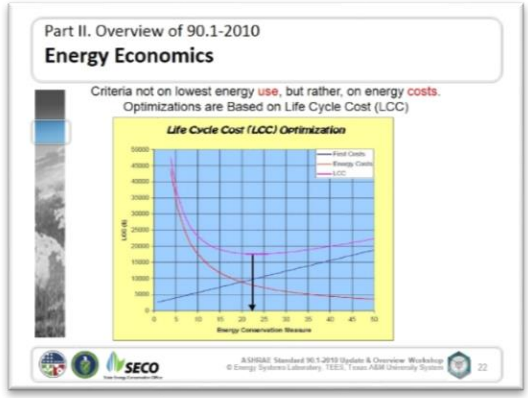


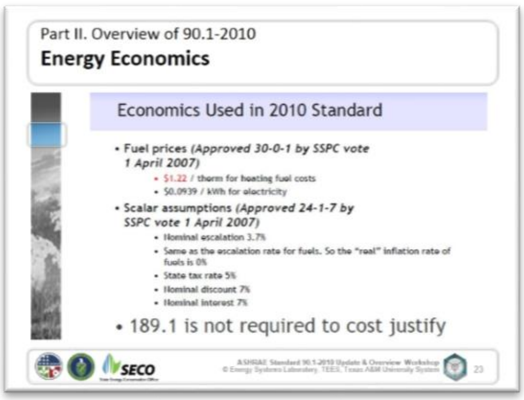
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)

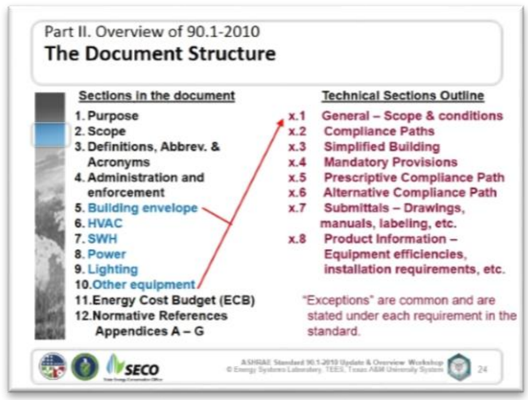


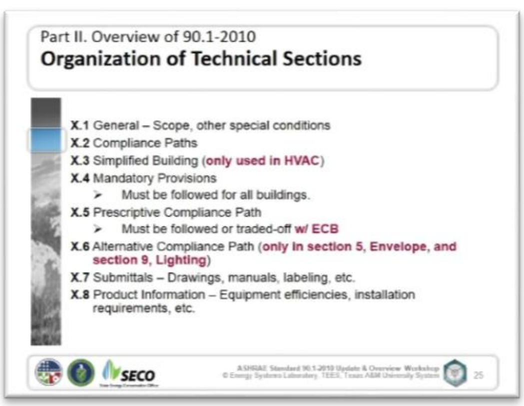


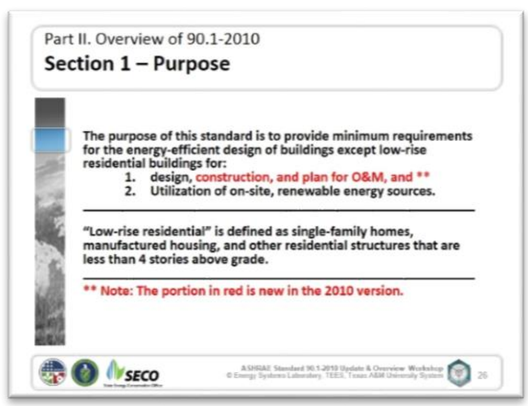

Part II. Overview of 90.1-2010
Document Overview
• It supercedes ANSI/ASHRAE/IESNA Standard 90.1-2007 by adding 60 Addenda.
• It will become the reference standard for the 2012 IECC.
• It is the professional "standard of care" for energy efficiency set by ASHRAE consensus.
• Format: Structured like a code document, with a consistent numbering scheme.
• Estimated savings compared to the 90.1-2007 version are about 25%, and about 30% compared to the 90.1-2004 version.
• Climate zones:
➢Defined geographically by county lines, not by individual city or climatic Degree Days.
➢Metropolitan areas kept together.
(221-page document)
ASHRAE STANDARD
Energy Standard for Buildings Except Low-Rise Residential Buildings
SECO
21

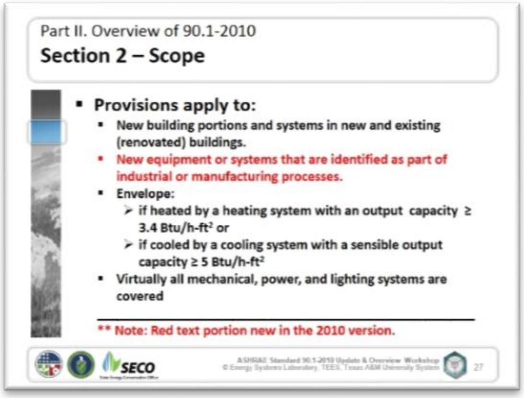

Part II. Overview of 90.1-2010
Energy Economics
Criteria not on lowest energy use, but rather, on energy costs.
Optimizations are Based on Life Cycle Cost (LCC)
Life Cycle Cost (LCC) Optimization
Energy Conservation Measure
SECO
22

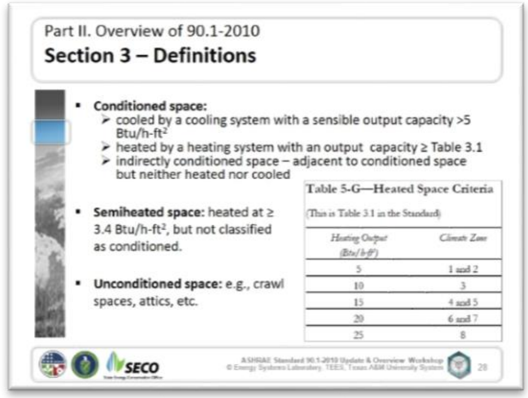

Part II. Overview of 90.1-2010
Energy Economics
Economics Used in 2010 Standard
• Fuel prices (Approved 30-0-1 by SSPC vote 1 April 2007)
• $1.22 / therm for heating fuel costs
• $0.0939 / kWh for electricity
• Scalar assumptions (Approved 24-1-7 by SSPC vote 1 April 2007)
• Nominal escalation 3.7%
• Same as the escalation rate for fuels. So the "real" inflation rate of fuels is 0%
• State tax rate 5%
• Nominal discount 7%
• Nominal interest 7%
• 189.1 is not required to cost justify
SECO
23

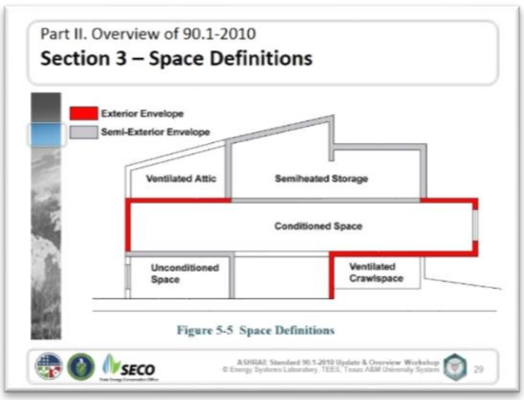

Part II. Overview of 90.1-2010
The Document Structure
Sections in the document
1. Purpose
2. Scope
3. Definitions, Abbrev. & Acronyms
4. Administration and enforcement
5. Building envelope
6. HVAC
7. SWH
8. Power
9. Lighting
10.Other equipment
11.Energy Cost Budget (ECB)
12.Normative References
Appendices A – G
Technical Sections Outline
x.1 General – Scope & conditions
x.2 Compliance Paths
x.3 Simplified Building
x.4 Mandatory Provisions
x.5 Prescriptive Compliance Path
x.6 Alternative Compliance Path
x.7 Submittals – Drawings, manuals, labeling, etc.
x.8 Product Information – Equipment efficiencies, installation requirements, etc.
"Exceptions" are common and are stated under each requirement in the standard.
SECO
24


Part II. Overview of 90.1-2010
Organization of Technical Sections
X.1 General – Scope, other special conditions
X.2 Compliance Paths
X.3 Simplified Building (only used in HVAC)
X.4 Mandatory Provisions
➢ Must be followed for all buildings.
X.5 Prescriptive Compliance Path
➢ Must be followed or traded-off w/ ECB
X.6 Alternative Compliance Path (only in section 5, Envelope, and section 9, Lighting)
X.7 Submittals – Drawings, manuals, labeling, etc.
X.8 Product Information – Equipment efficiencies, installation requirements, etc.
SECO
25


Part II. Overview of 90.1-2010
Section 1 – Purpose
The purpose of this standard is to provide minimum requirements for the energy-efficient design of buildings except low-rise residential buildings for:
1. design, construction, and plan for O&M, and **
2. Utilization of on-site, renewable energy sources.
"Low-rise residential" is defined as single-family homes, manufactured housing, and other residential structures that are less than 4 stories above grade.
** Note: The portion in red is new in the 2010 version.
SECO
26







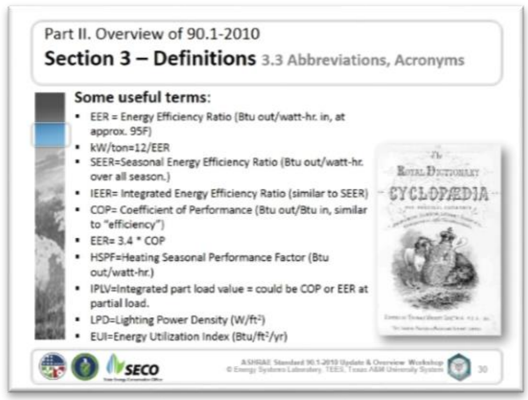
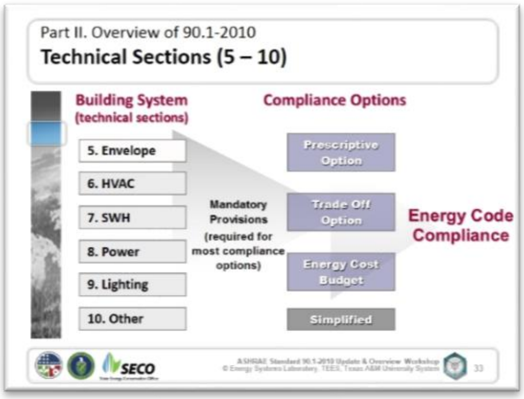
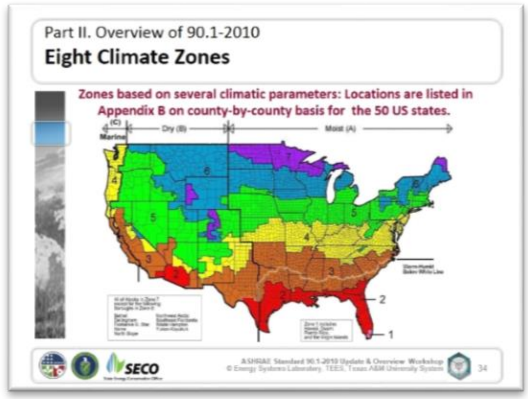
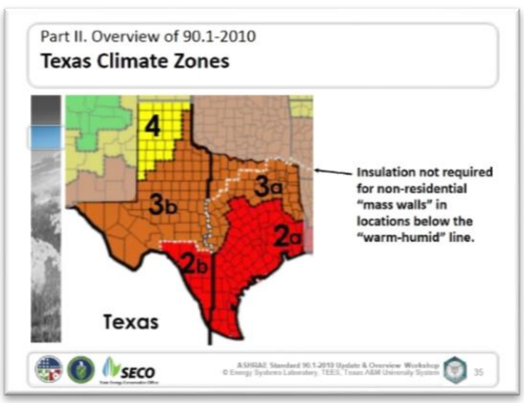


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)







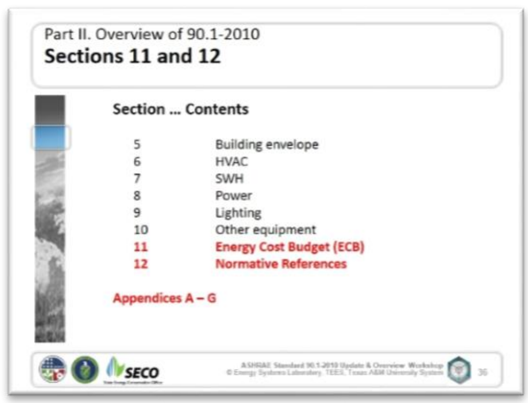
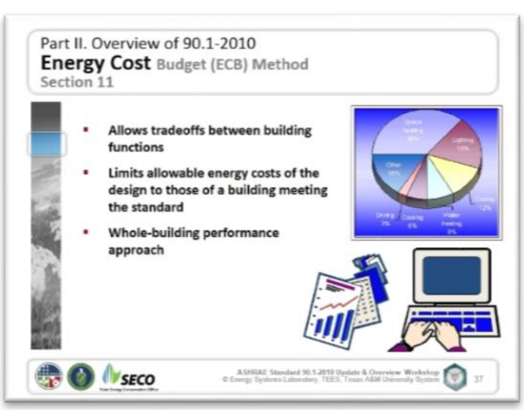
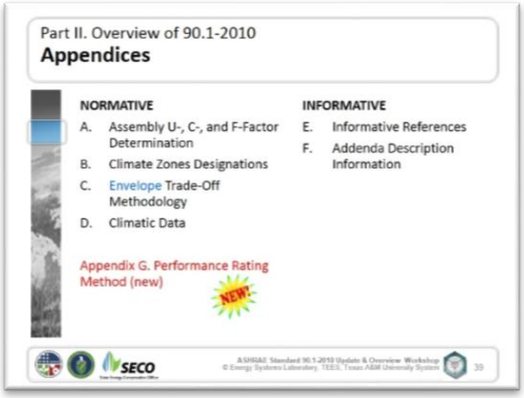
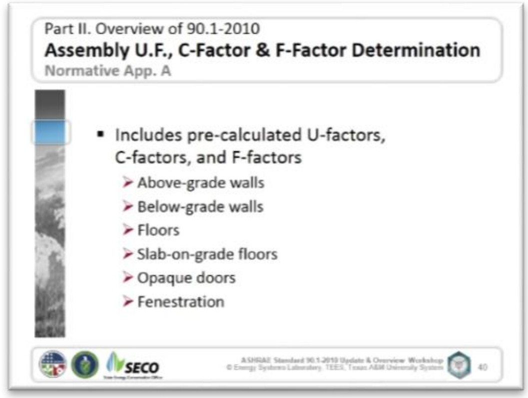
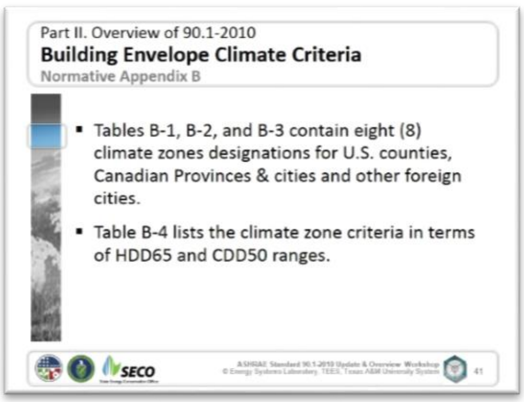


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









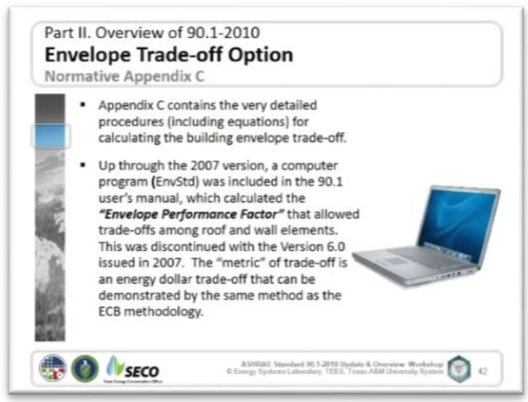
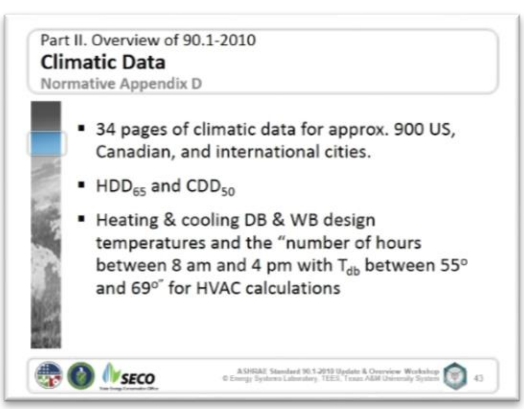
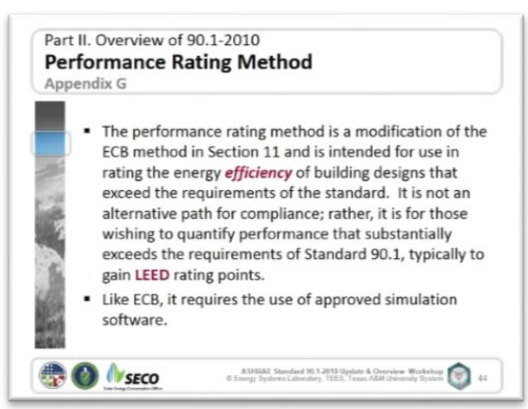
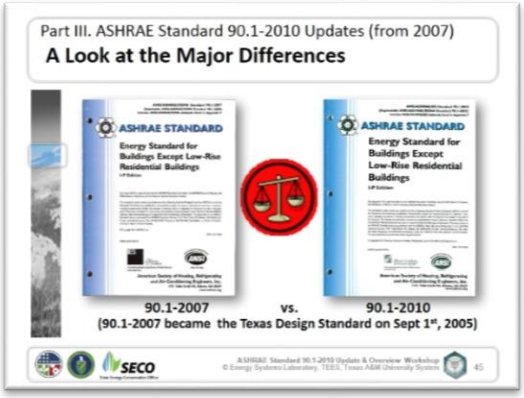
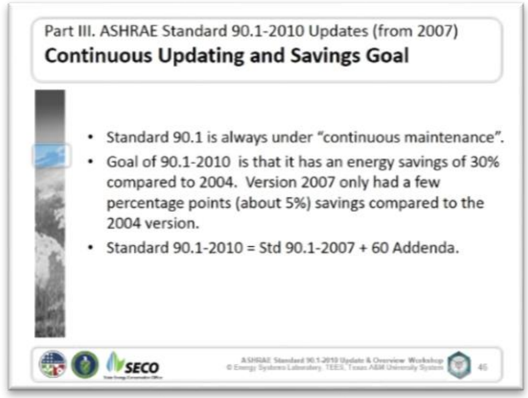


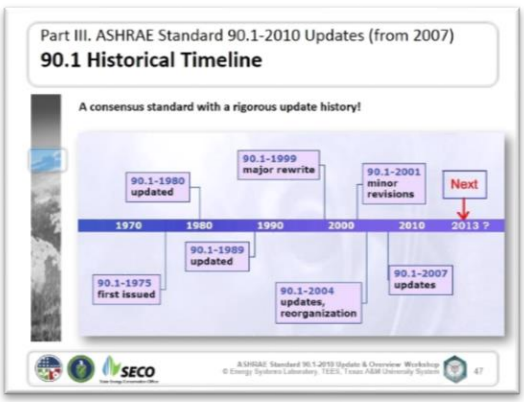
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











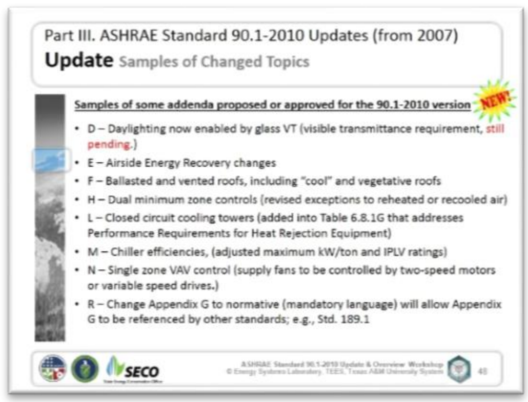
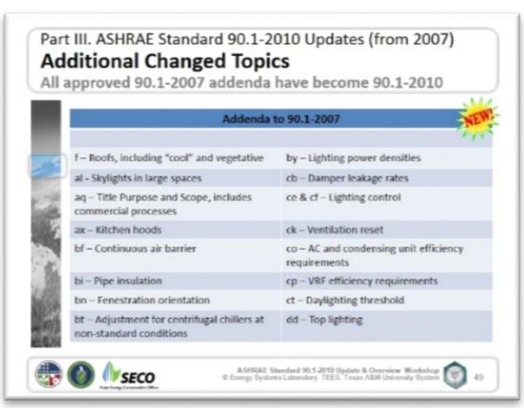
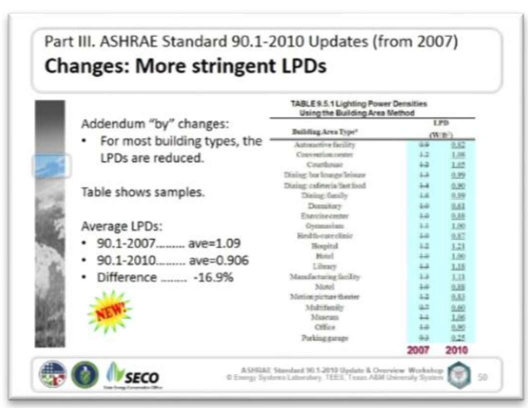
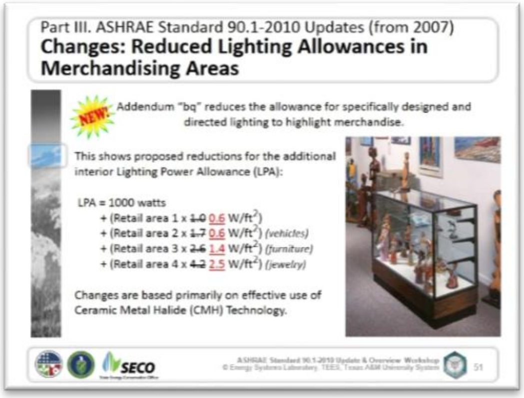
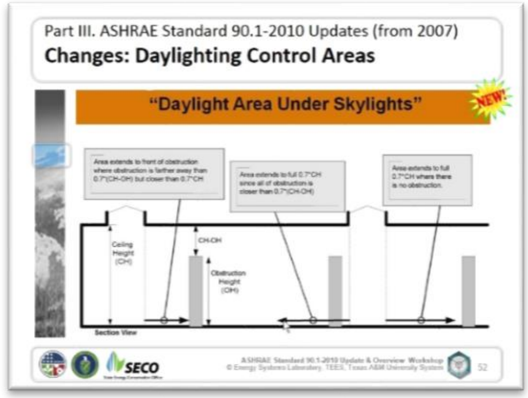


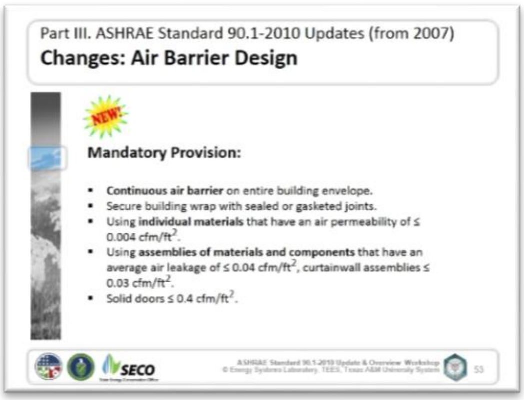
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











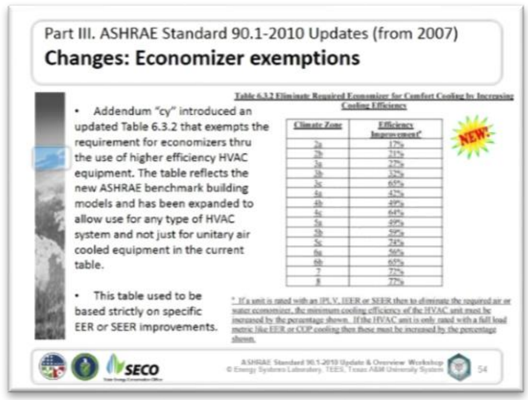
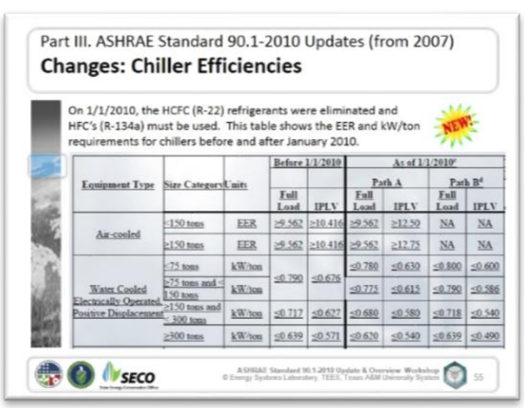
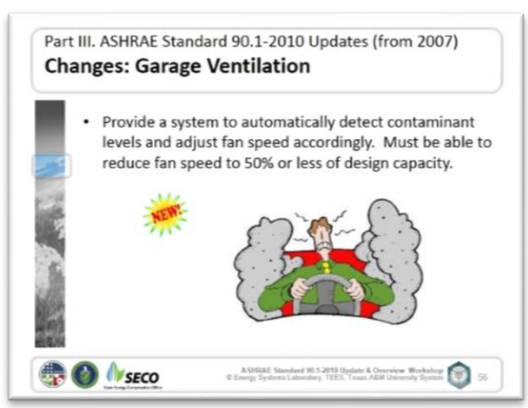
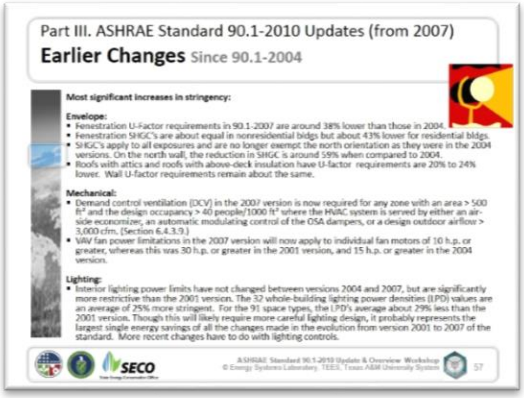
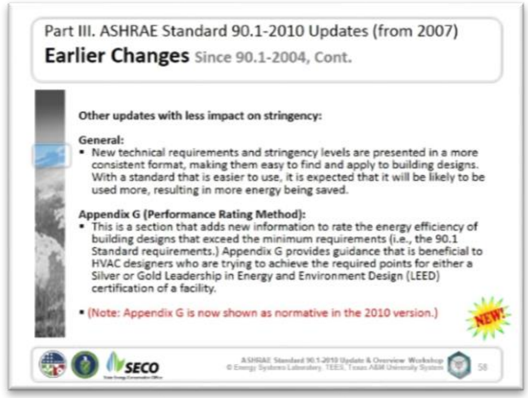


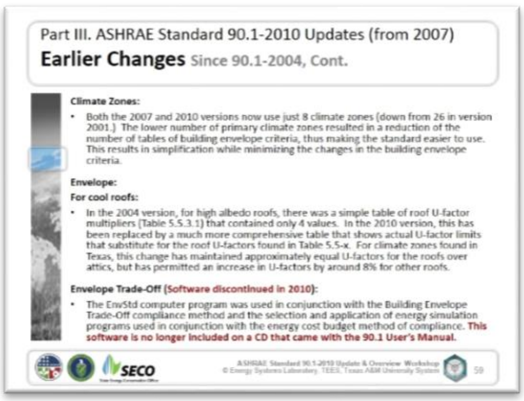
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











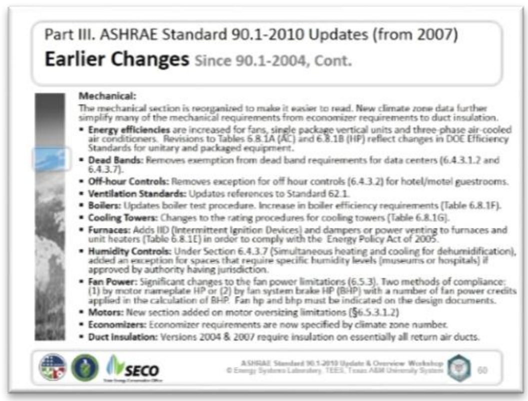
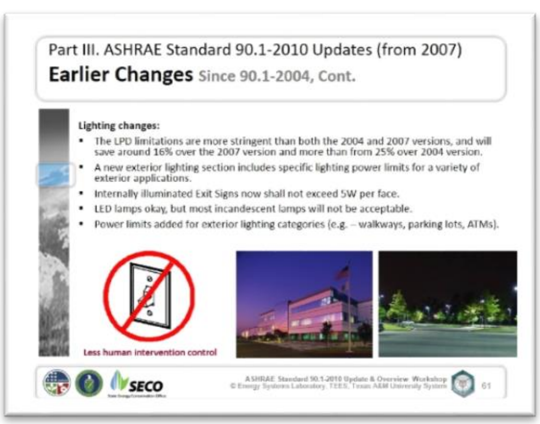
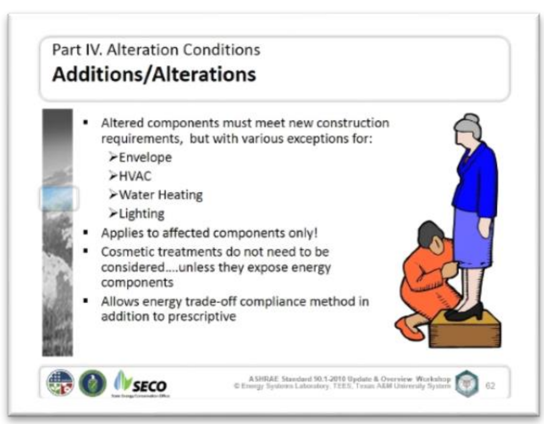
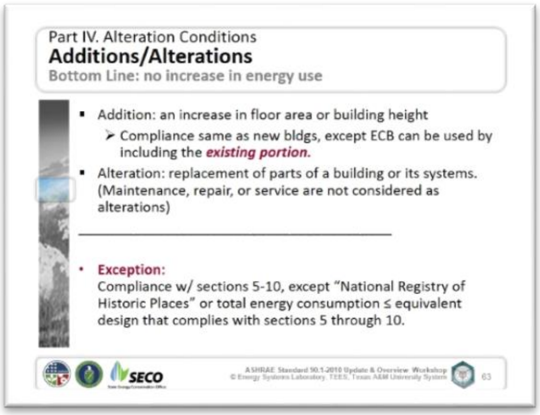
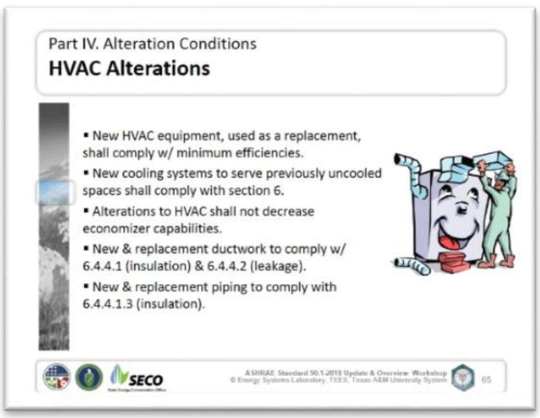


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









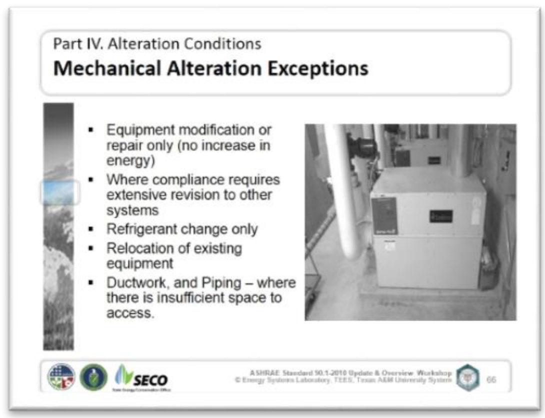


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)

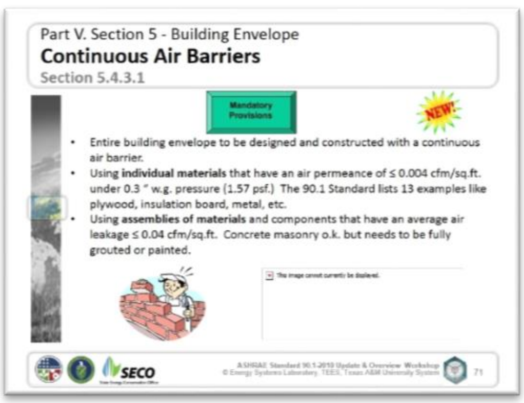
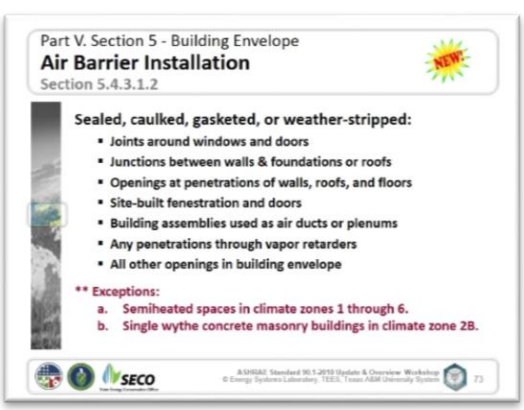
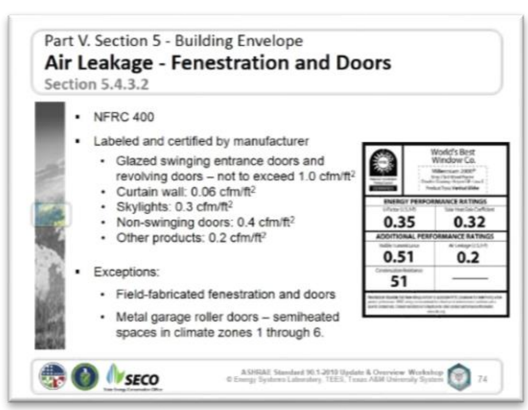
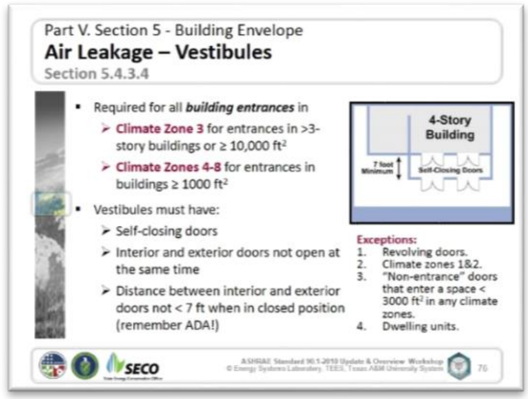
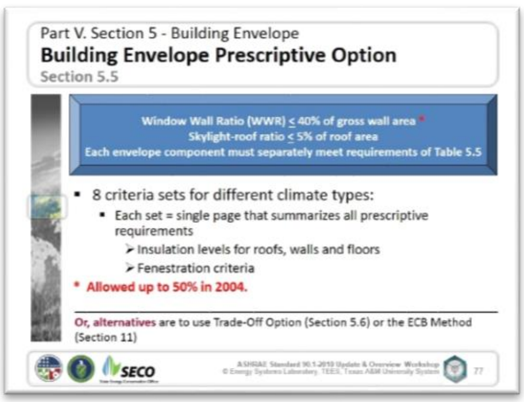


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









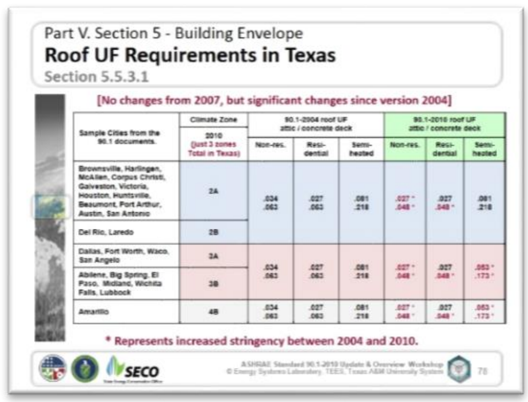
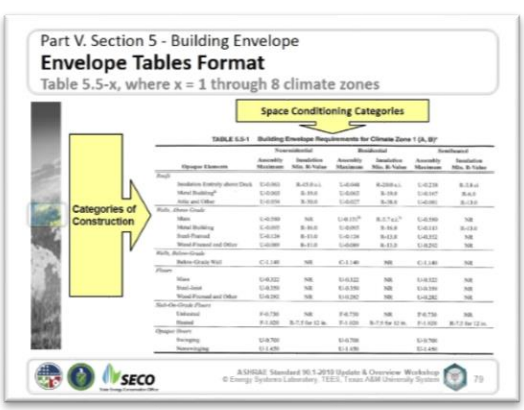
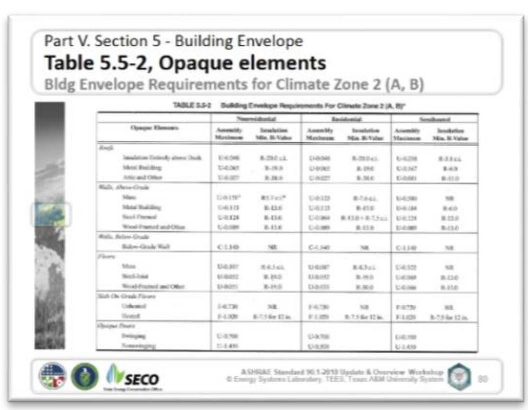
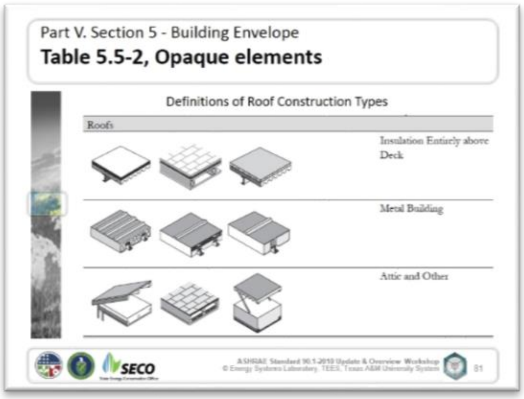
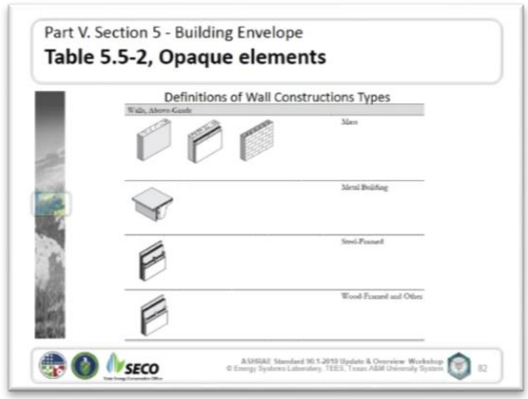


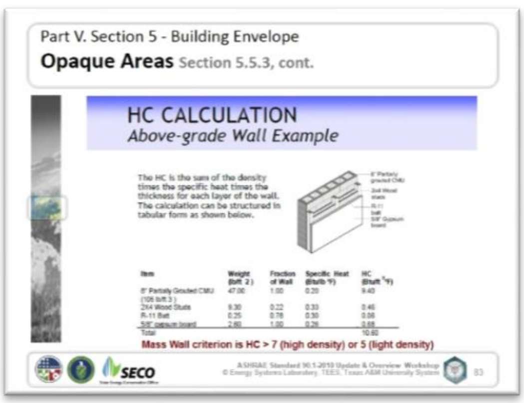
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











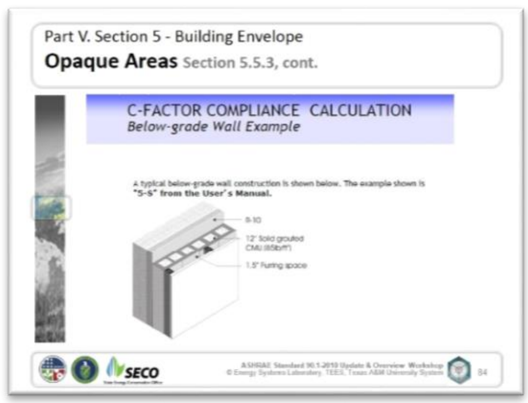
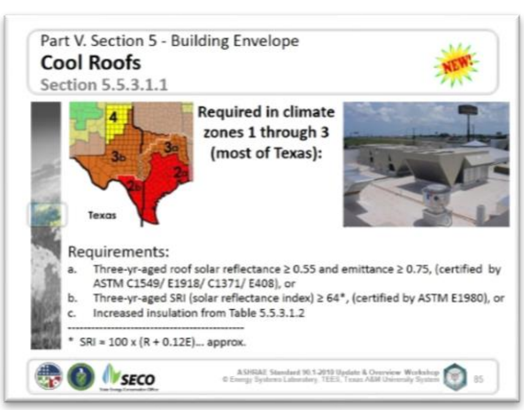
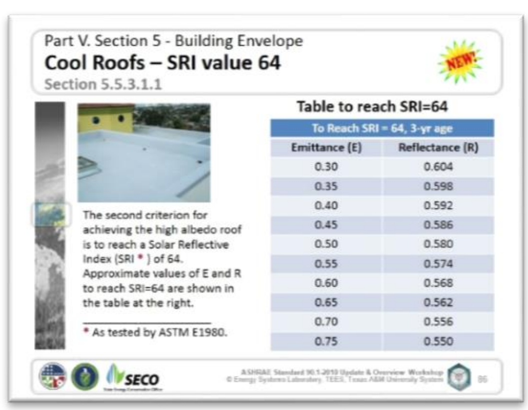
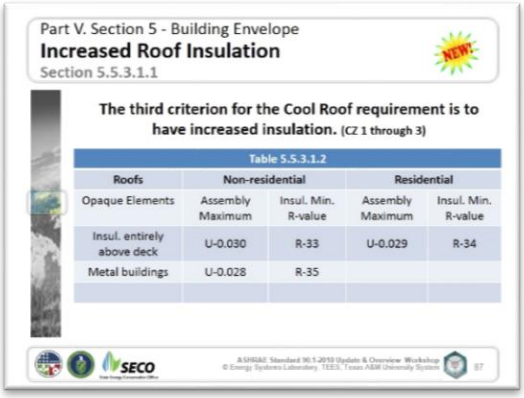


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)







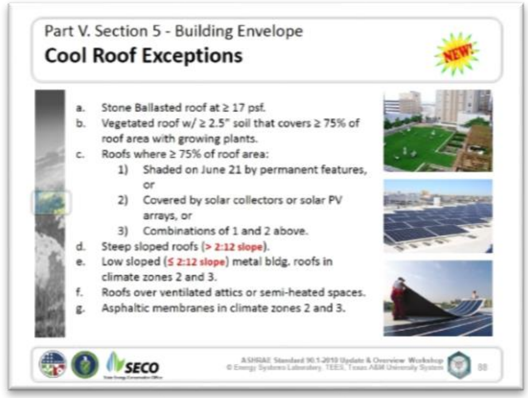
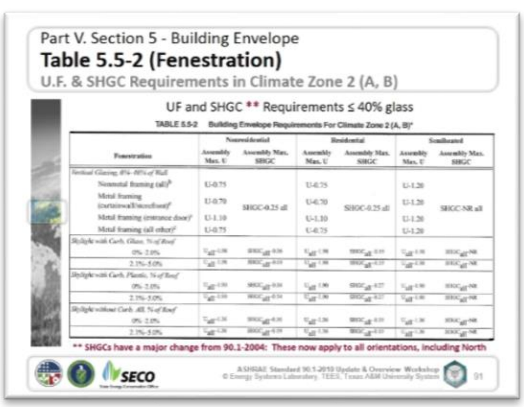
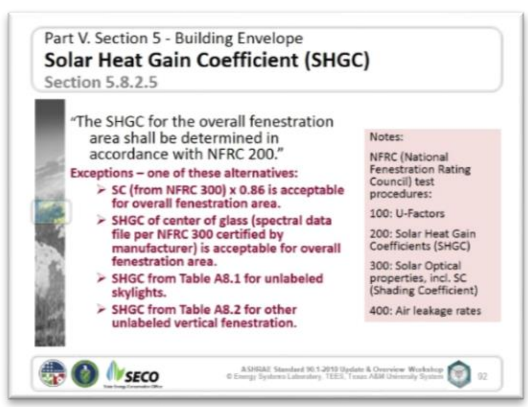
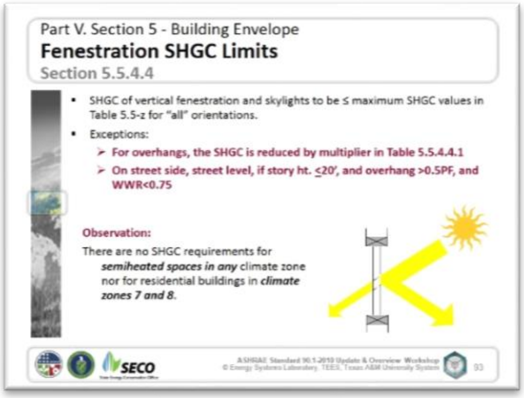
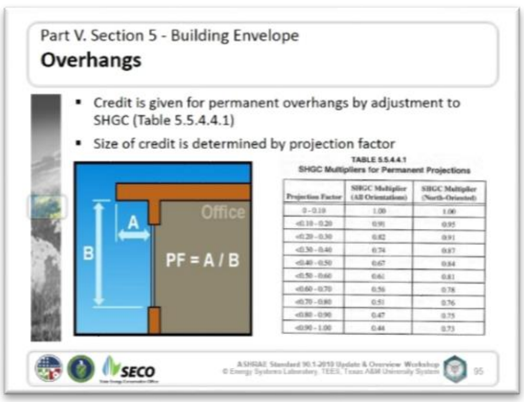


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









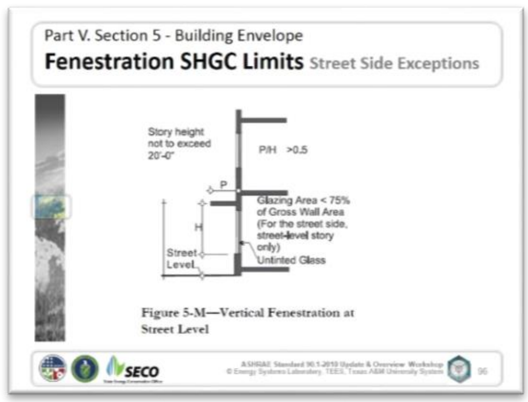
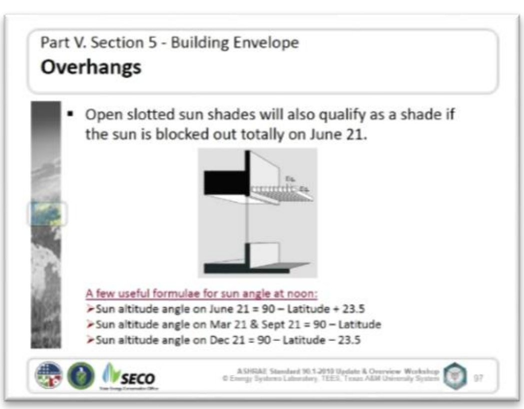
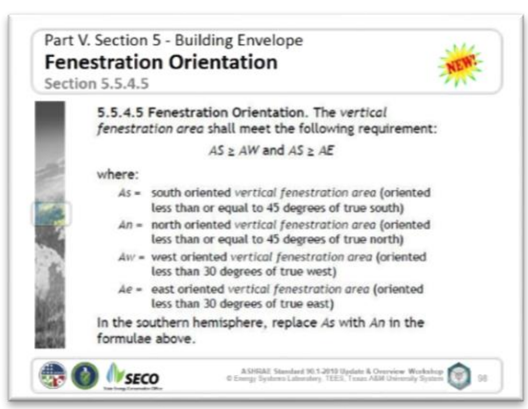
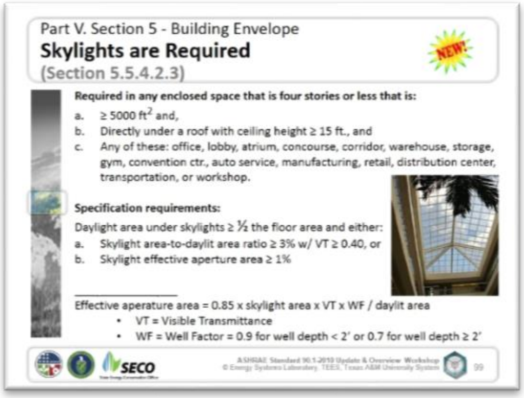
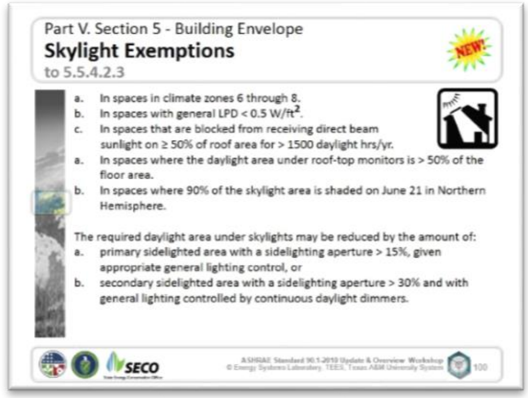


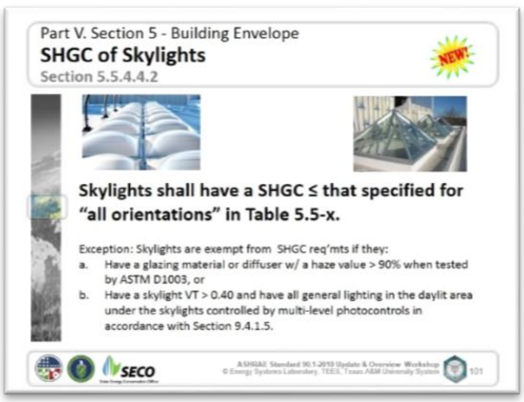
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











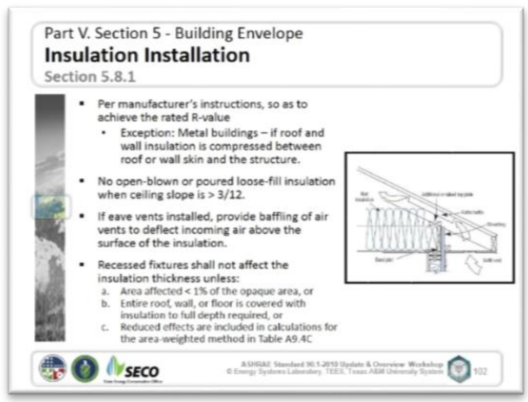
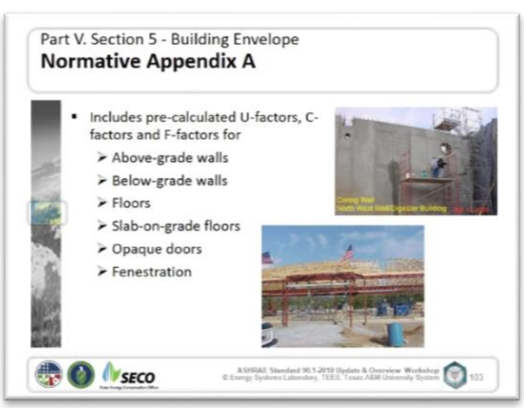
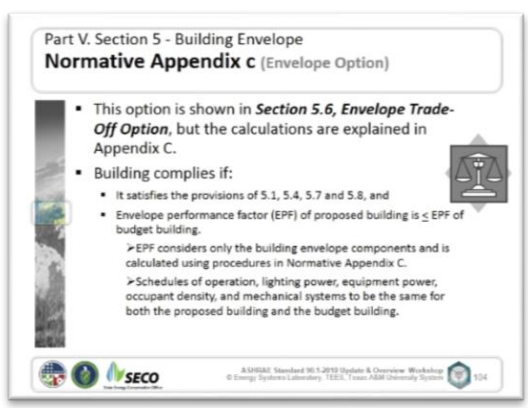
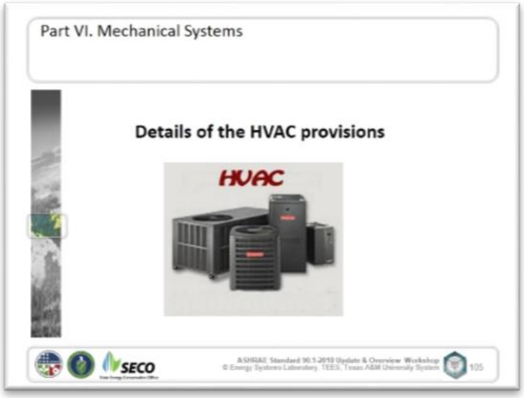
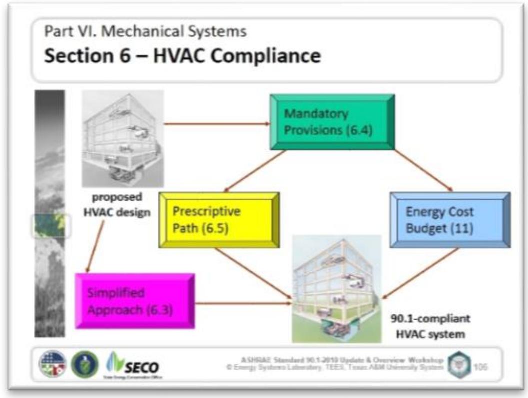


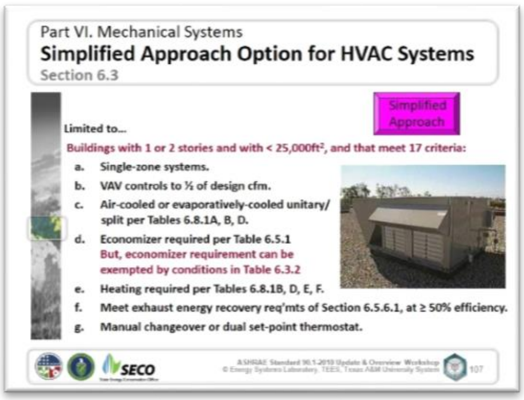
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











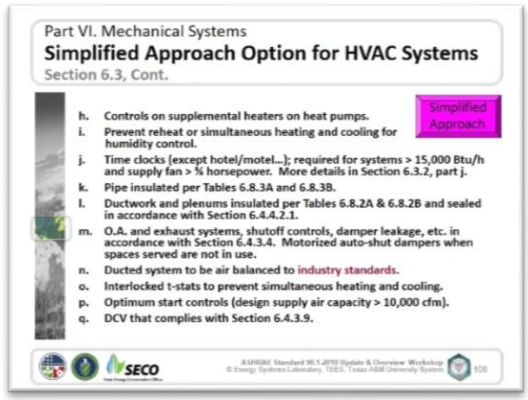
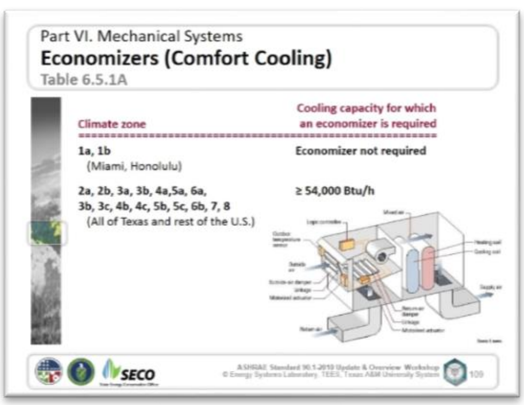
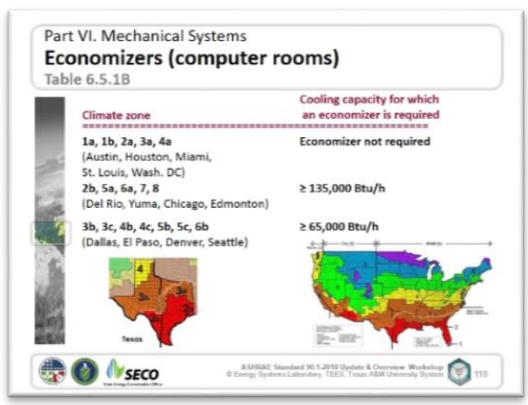
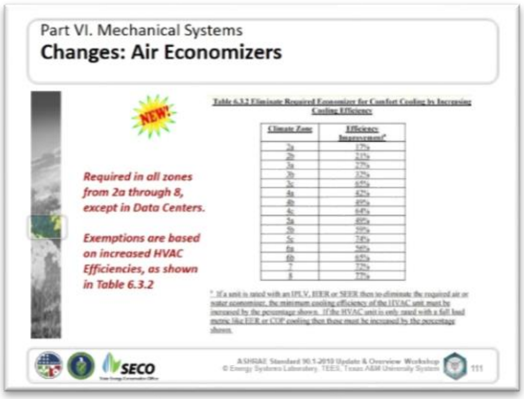
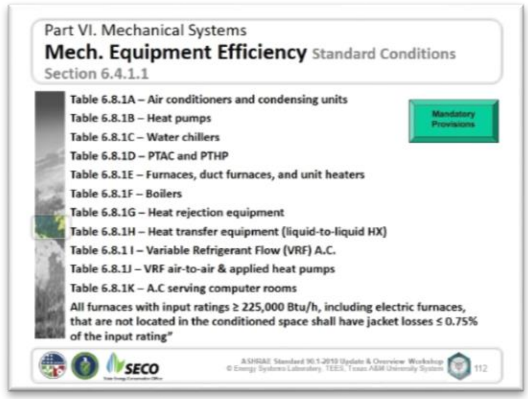


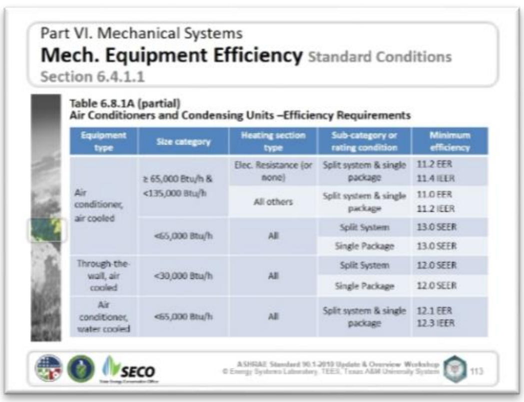
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











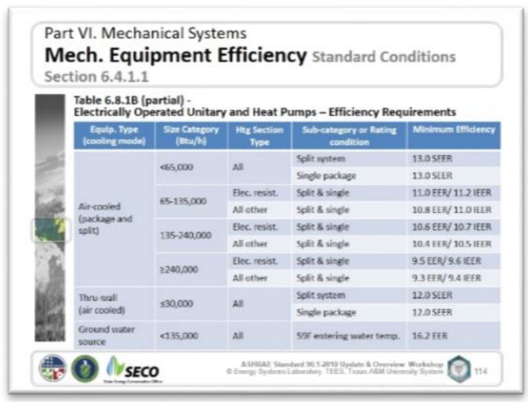
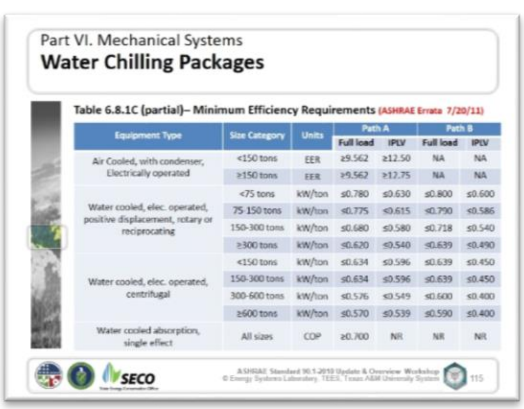
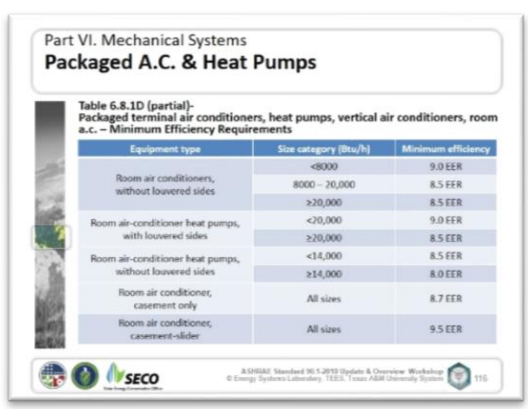
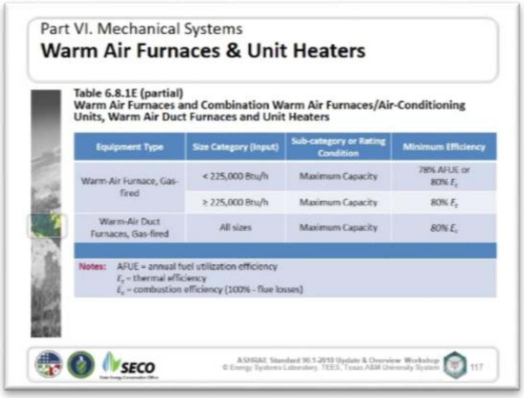


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)







Part VI. Mechanical Systems

Warm Air Furnaces & Unit Heaters

Table 6.8.1E (partial)
Warm Air Furnaces and Combination Warm Air Furnaces/Air-Conditioning Units, Warm Air Duct Furnaces and Unit Heaters

Equipment Type	Size Category (Input)	Sub-category or Rating Condition	Minimum Efficiency
Warm-Air Furnace, Gas-fired	< 225,000 Btu/h	Maximum Capacity	78% AFUE or 80% E_t
	≥ 225,000 Btu/h	Maximum Capacity	80% E_t
Warm-Air Duct Furnaces, Gas-fired	All sizes	Maximum Capacity	80% E_c

Notes: AFUE = annual fuel utilization efficiency
E_t – thermal efficiency
E_c – combustion efficiency (100% - flue losses)

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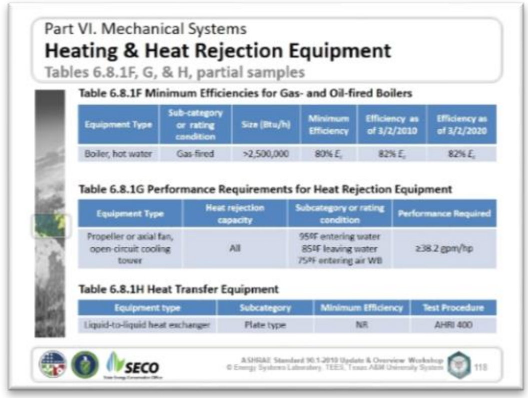

Part VI. Mechanical Systems

Heating & Heat Rejection Equipment

Tables 6.8.1F, G, & H, partial samples

Table 6.8.1F Minimum Efficiencies for Gas- and Oil-fired Boilers

Equipment Type	Sub-category or rating condition	Size (Btu/h)	Minimum Efficiency	Efficiency as of 3/2/2010	Efficiency as of 3/2/2020
Boiler, hot water	Gas-fired	>2,500,000	80% E_c	82% E_c	82% E_c

Table 6.8.1G Performance Requirements for Heat Rejection Equipment

Equipment Type	Heat rejection capacity	Subcategory or rating condition	Performance Required
Propeller or axial fan, open-circuit cooling tower	All	95ºF entering water 85ºF leaving water 75ºF entering air WB	≥38.2 gpm/hp

Table 6.8.1H Heat Transfer Equipment

Equipment type	Subcategory	Minimum Efficiency	Test Procedure
Liquid-to-liquid heat exchanger	Plate type	NR	AHRI 400

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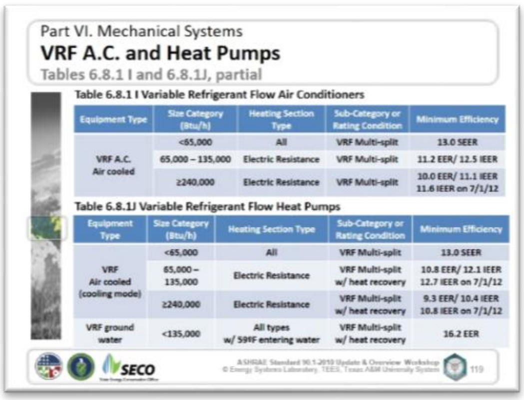

Part VI. Mechanical Systems

VRF A.C. and Heat Pumps

Tables 6.8.1 I and 6.8.1J, partial

Table 6.8.1 I Variable Refrigerant Flow Air Conditioners

Equipment Type	Size Category (Btu/h)	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency
VRF A.C. Air cooled	<65,000	All	VRF Multi-split	13.0 SEER
	65,000 – 135,000	Electric Resistance	VRF Multi-split	11.2 EER/ 12.5 IEER
	≥240,000	Electric Resistance	VRF Multi-split	10.0 EER/ 11.1 IEER 11.6 IEER on 7/1/12

Table 6.8.1J Variable Refrigerant Flow Heat Pumps

Equipment Type	Size Category (Btu/h)	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency
VRF Air cooled (cooling mode)	<65,000	All	VRF Multi-split	13.0 SEER
	65,000 – 135,000	Electric Resistance	VRF Multi-split w/ heat recovery	10.8 EER/ 12.1 IEER 12.7 IEER on 7/1/12
	≥240,000	Electric Resistance	VRF Multi-split w/ heat recovery	9.3 EER/ 10.4 IEER 10.8 IEER on 7/1/12
VRF ground water	<135,000	All types w/ 59ºF entering water	VRF Multi-split w/ heat recovery	16.2 EER

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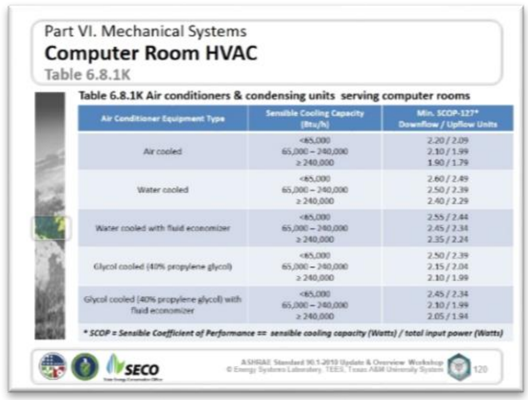

Part VI. Mechanical Systems

Computer Room HVAC

Table 6.8.1K

Table 6.8.1K Air conditioners & condensing units serving computer rooms

Air Conditioner Equipment Type	Sensible Cooling Capacity (Btu/h)	Min. SCOP-127* Downflow / Upflow Units
Air cooled	<65,000 65,000 – 240,000 ≥ 240,000	2.20 / 2.09 2.10 / 1.99 1.90 / 1.79
Water cooled	<65,000 65,000 – 240,000 ≥ 240,000	2.60 / 2.49 2.50 / 2.39 2.40 / 2.29
Water cooled with fluid economizer	<65,000 65,000 – 240,000 ≥ 240,000	2.55 / 2.44 2.45 / 2.34 2.35 / 2.24
Glycol cooled (40% propylene glycol)	<65,000 65,000 – 240,000 ≥ 240,000	2.50 / 2.39 2.15 / 2.04 2.10 / 1.99
Glycol cooled (40% propylene glycol) with fluid economizer	<65,000 65,000 – 240,000 ≥ 240,000	2.45 / 2.34 2.10 / 1.99 2.05 / 1.94

** SCOP = Sensible Coefficient of Performance == sensible cooling capacity (Watts) / total input power (Watts)*

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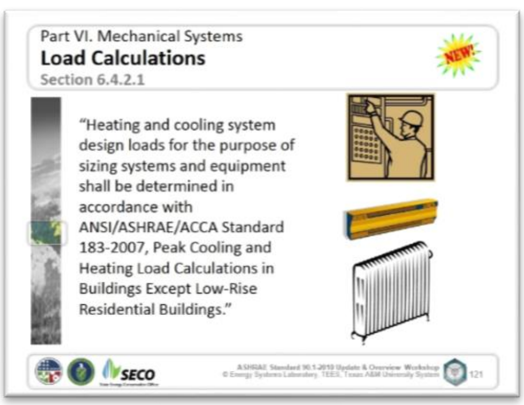
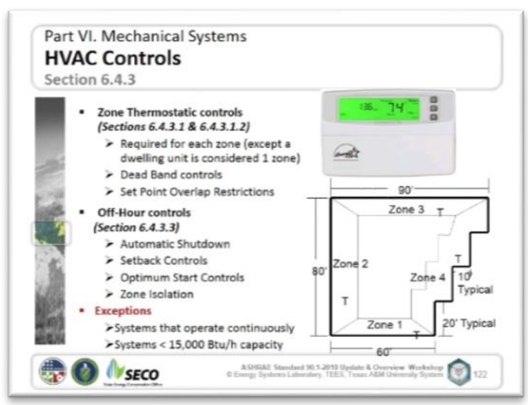
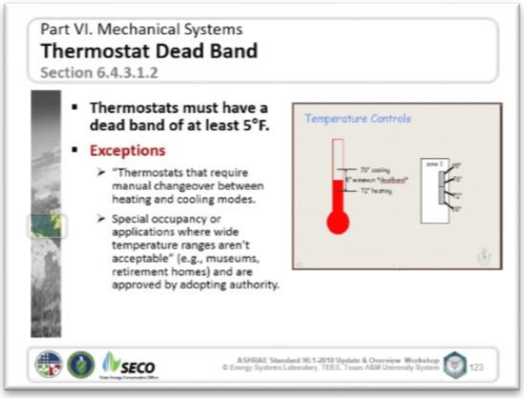
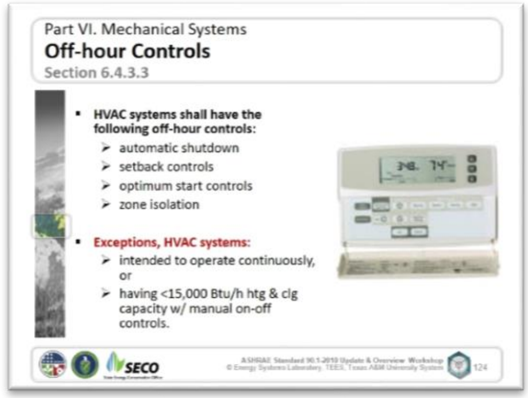
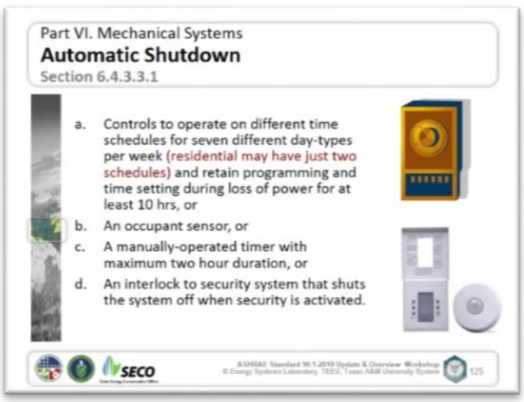
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











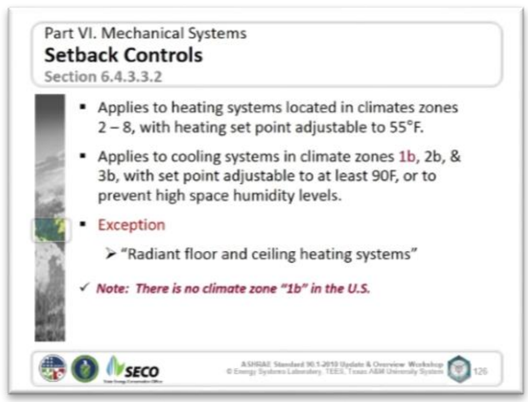
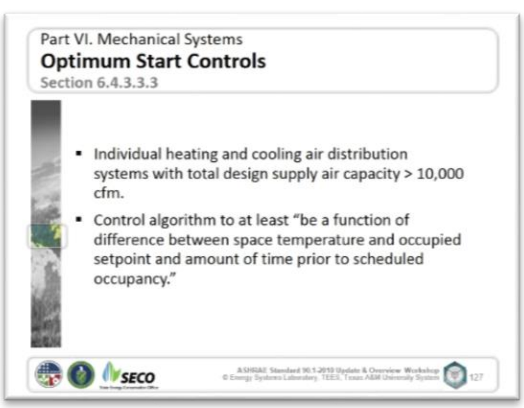
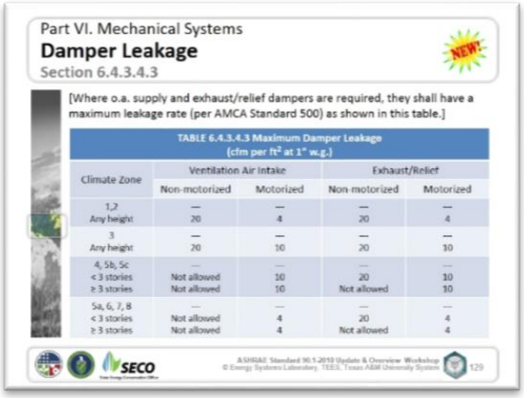


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)





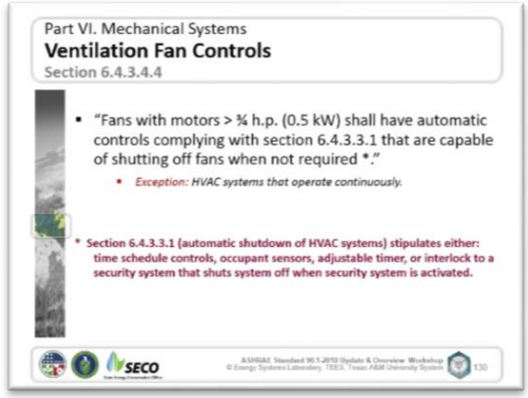
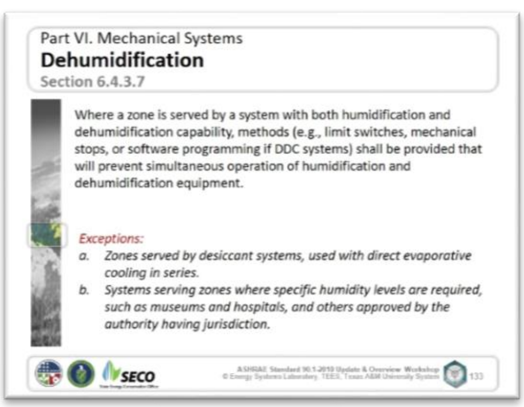
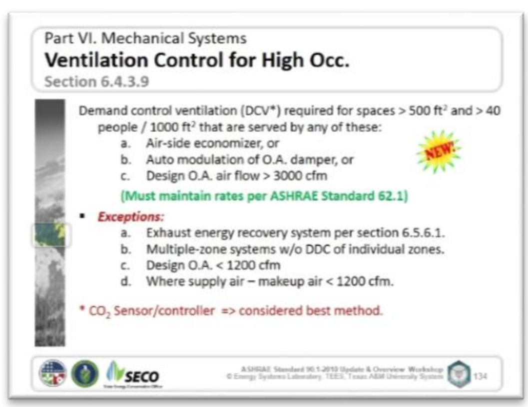
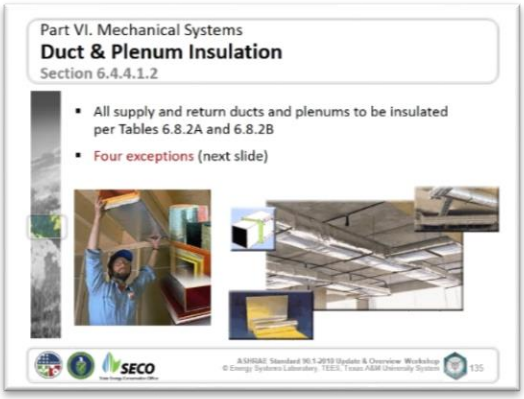
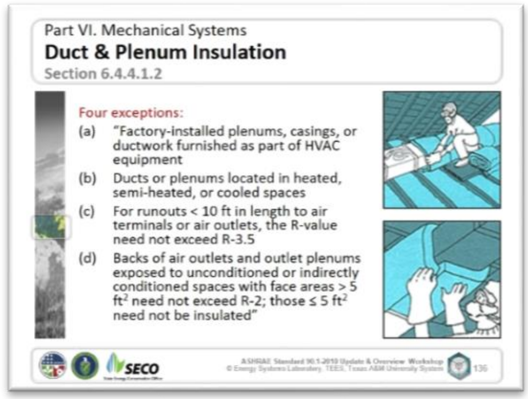


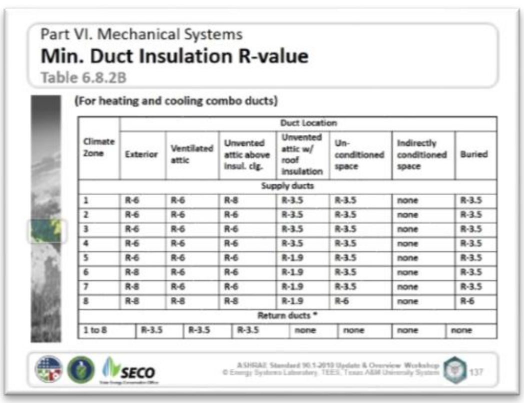
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











Climate Zone	Duct Location						
	Exterior	Ventilated attic	Unvented attic above insul. clg.	Unvented attic w/ roof insulation	Un-conditioned space	Indirectly conditioned space	Buried
Supply ducts							
1	R-6	R-6	R-8	R-3.5	R-3.5	none	R-3.5
2	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
3	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
4	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
5	R-6	R-6	R-6	R-1.9	R-3.5	none	R-3.5
6	R-8	R-6	R-6	R-1.9	R-3.5	none	R-3.5
7	R-8	R-6	R-6	R-1.9	R-3.5	none	R-3.5
8	R-8	R-8	R-8	R-1.9	R-6	none	R-6
Return ducts *							
1 to 8	R-3.5	R-3.5	R-3.5	none	none	none	none

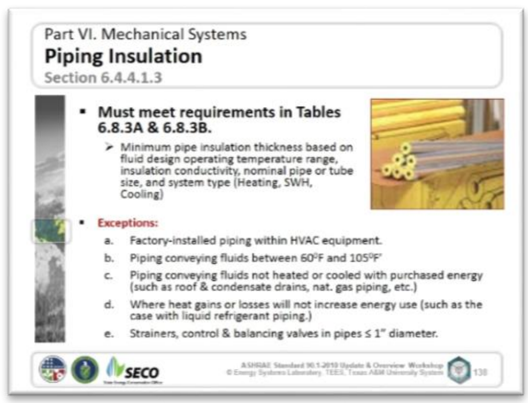
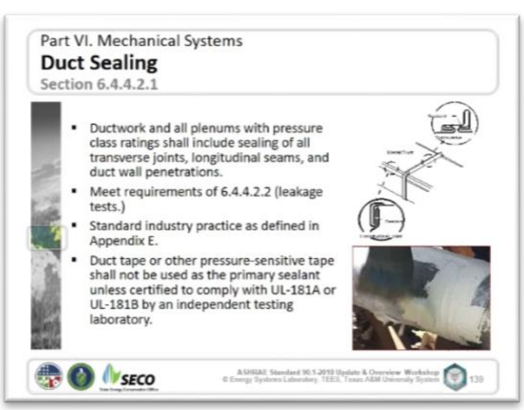
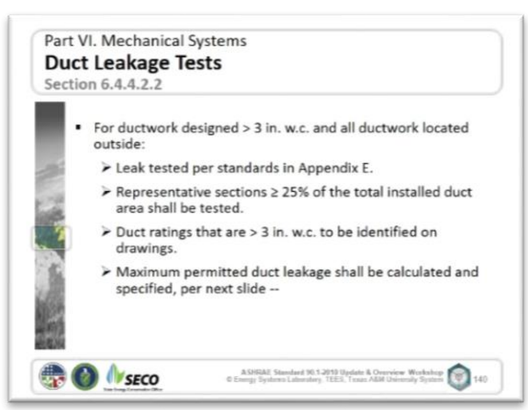
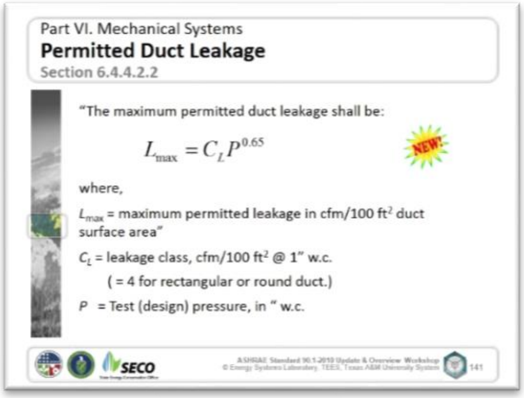
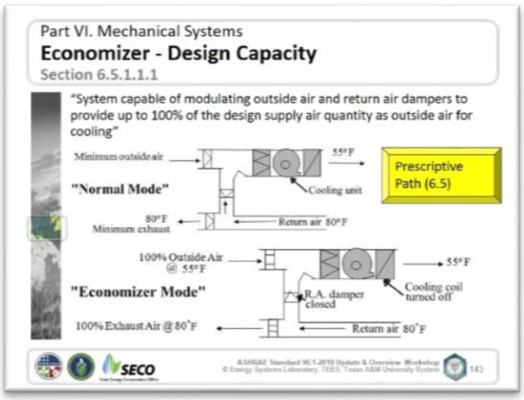


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









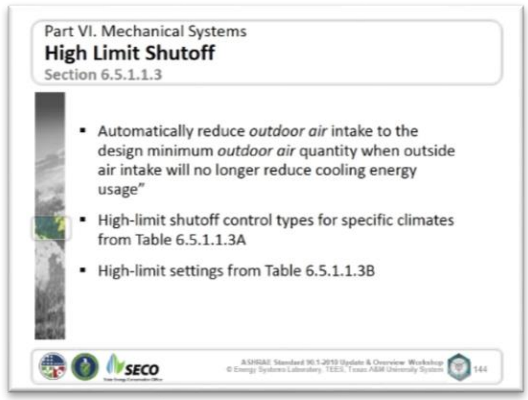


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)

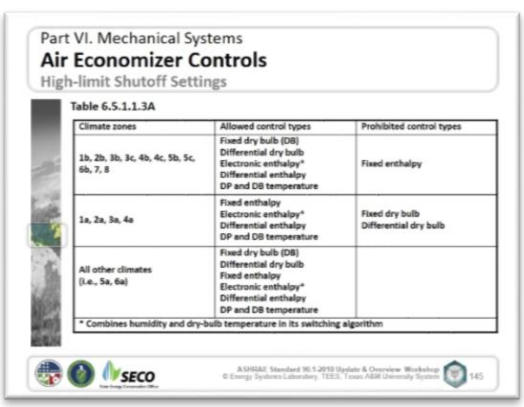
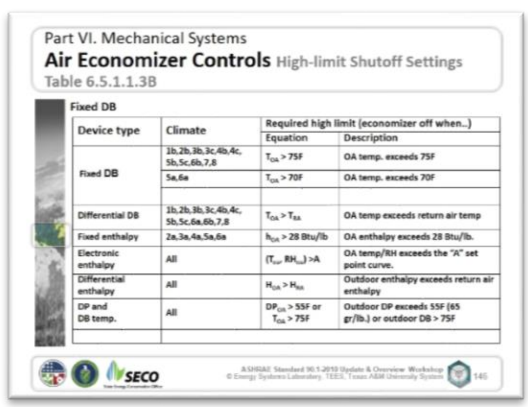


Table 6.5.1.1.3A

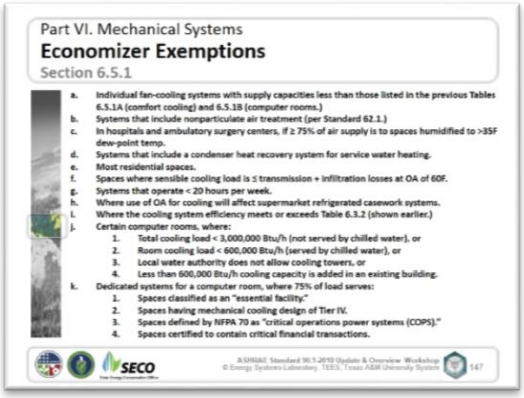
Climate zones	Allowed control types	Prohibited control types
1b, 2b, 3b, 3c, 4b, 4c, 5b, 5c, 6b, 7, 8	Fixed dry bulb (DB) Differential dry bulb Electronic enthalpy* Differential enthalpy DP and DB temperature	Fixed enthalpy
1a, 2a, 3a, 4a	Fixed enthalpy Electronic enthalpy* Differential enthalpy DP and DB temperature	Fixed dry bulb Differential dry bulb
All other climates (i.e., 5a, 6a)	Fixed dry bulb (DB) Differential dry bulb Fixed enthalpy Electronic enthalpy* Differential enthalpy DP and DB temperature	

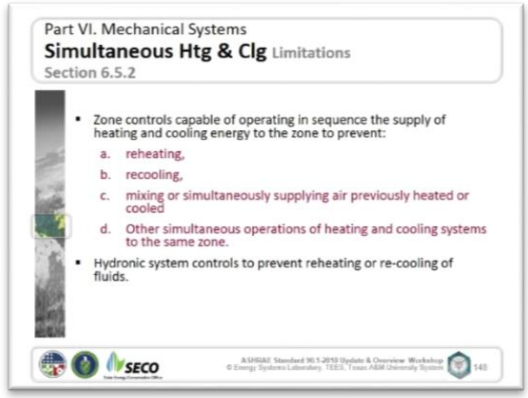
* Combines humidity and dry-bulb temperature in its switching algorithm

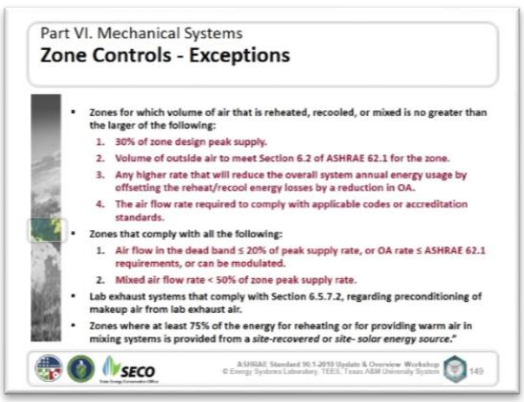


Fixed DB

Device type	Climate	Required high limit (economizer off when..)	
		Equation	Description
Fixed DB	1b,2b,3b,3c,4b,4c, 5b,5c,6b,7,8	$T_{OA} > 75F$	OA temp. exceeds 75F
	5a,6a	$T_{OA} > 70F$	OA temp. exceeds 70F
Differential DB	1b,2b,3b,3c,4b,4c, 5b,5c,6a,6b,7,8	$T_{OA} > T_{RA}$	OA temp exceeds return air temp
Fixed enthalpy	2a,3a,4a,5a,6a	$h_{OA} > 28$ Btu/lb	OA enthalpy exceeds 28 Btu/lb.
Electronic enthalpy	All	$(T_{OA}, RH_{OA}) > A$	OA temp/RH exceeds the "A" set point curve.
Differential enthalpy	All	$H_{OA} > H_{RA}$	Outdoor enthalpy exceeds return air enthalpy
DP and DB temp.	All	$DP_{OA} > 55F$ or $T_{OA} > 75F$	Outdoor DP exceeds 55F (65 gr/lb.) or outdoor DB > 75F







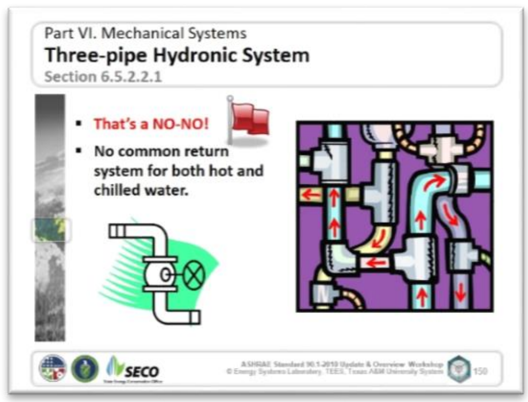
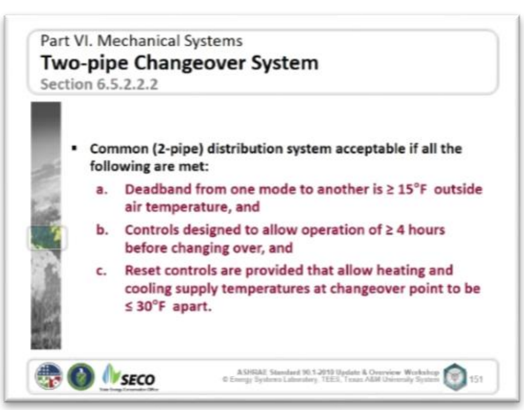
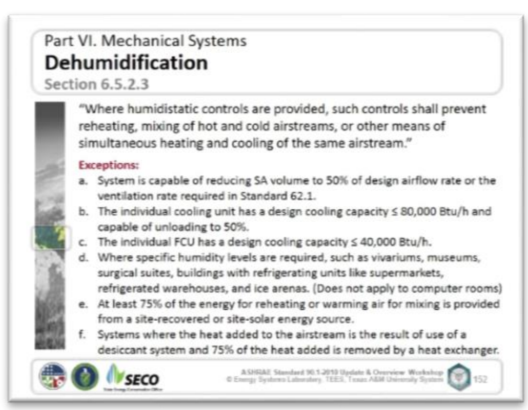
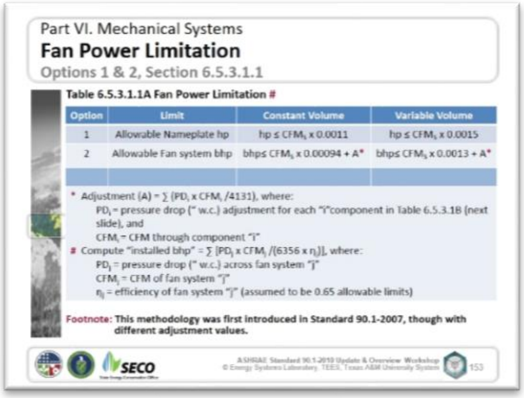
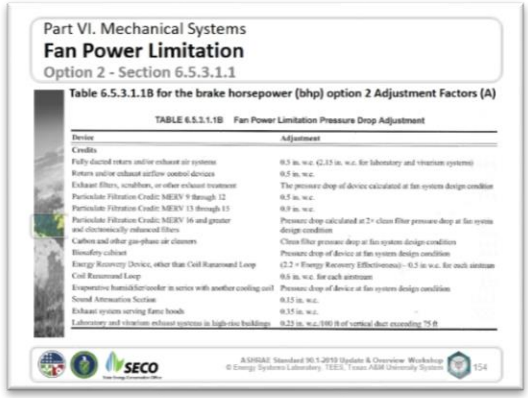


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









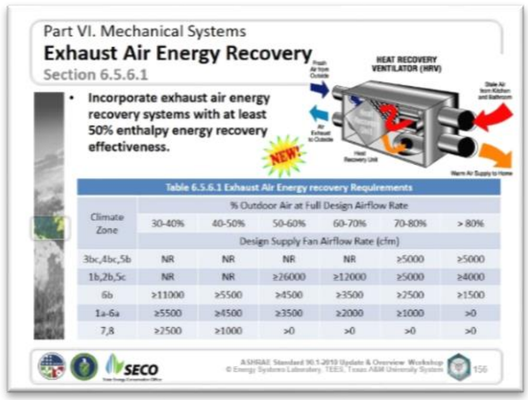
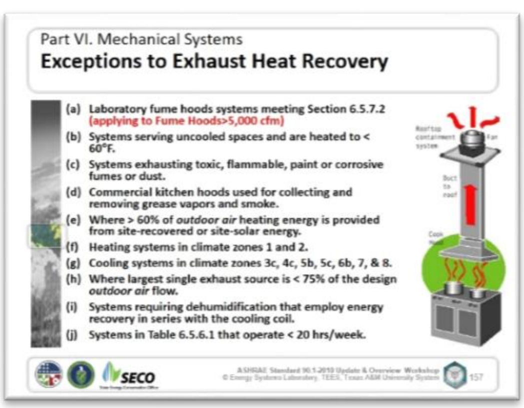
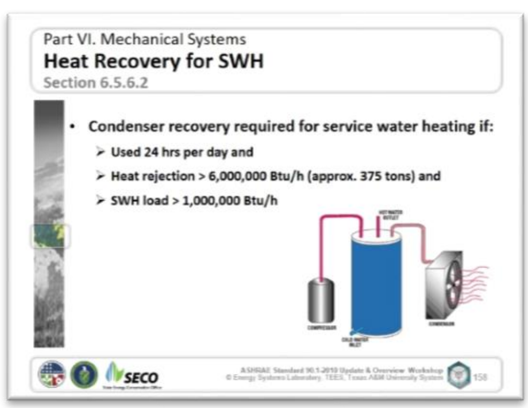
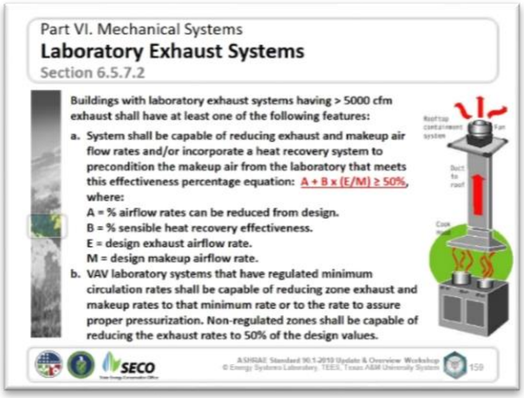
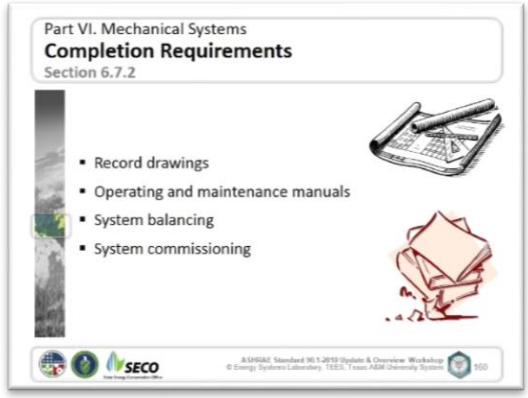


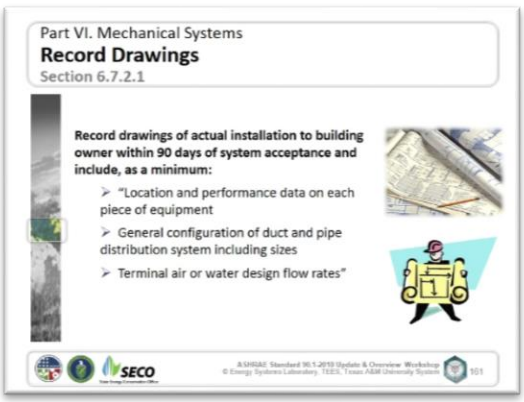
Figure 24: SHRAE 90.1 Standard Update Workshop (continued)











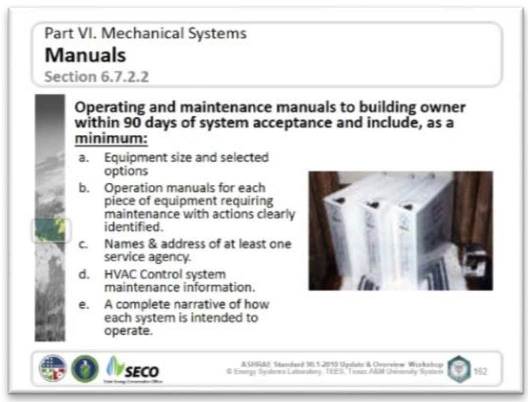
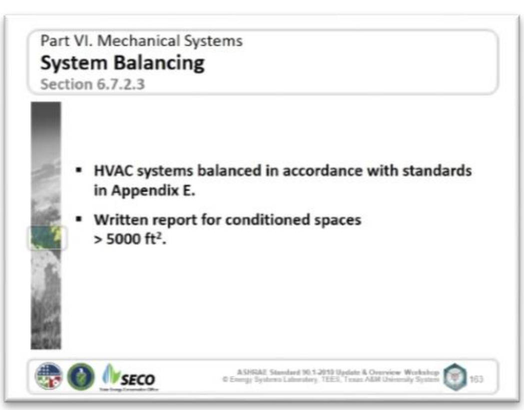
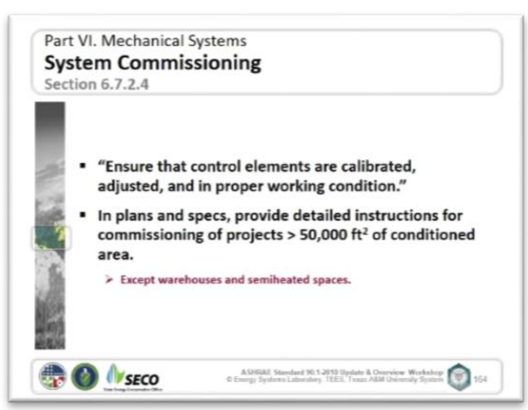
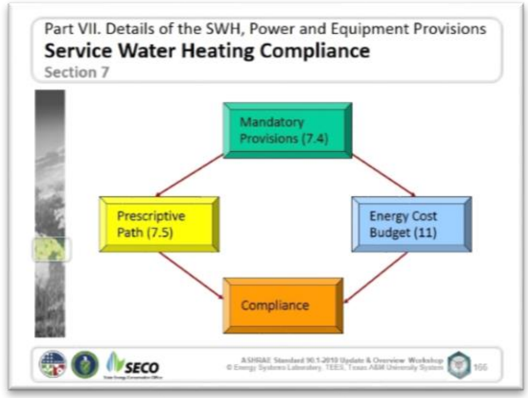


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)







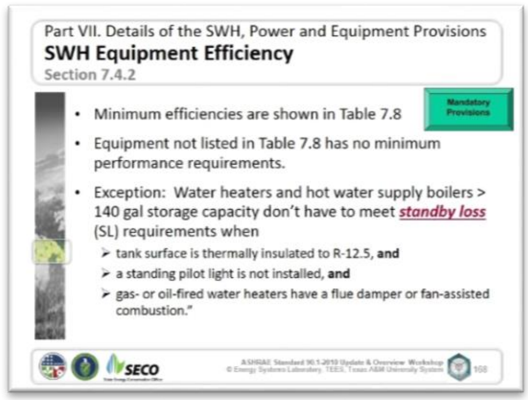
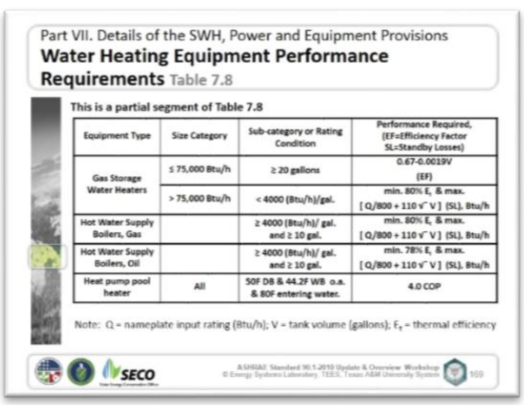
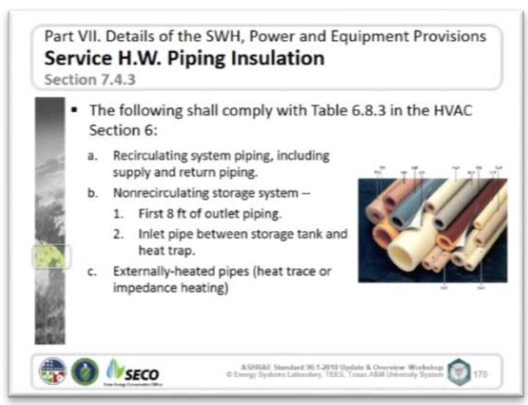
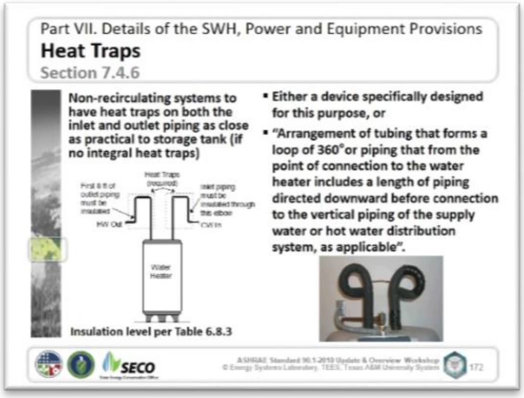
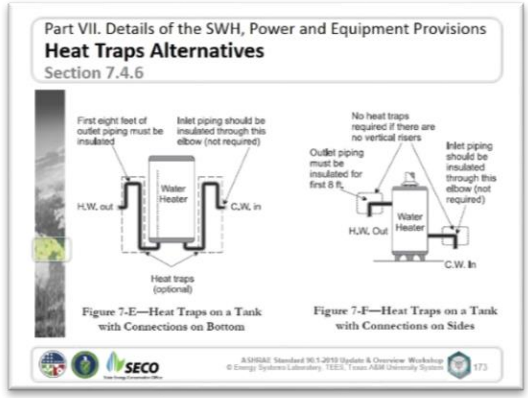


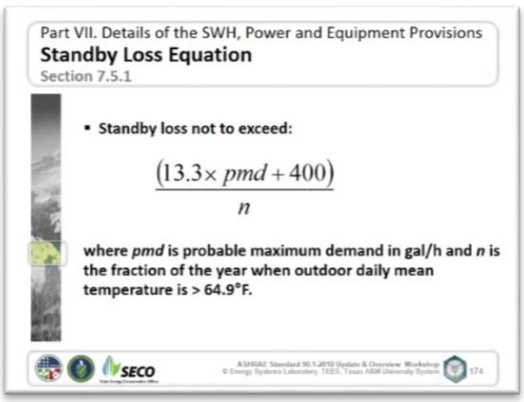
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











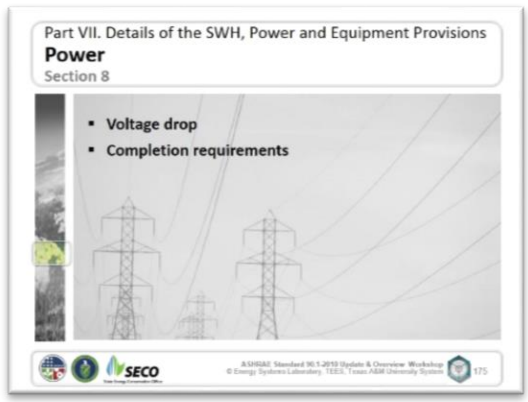
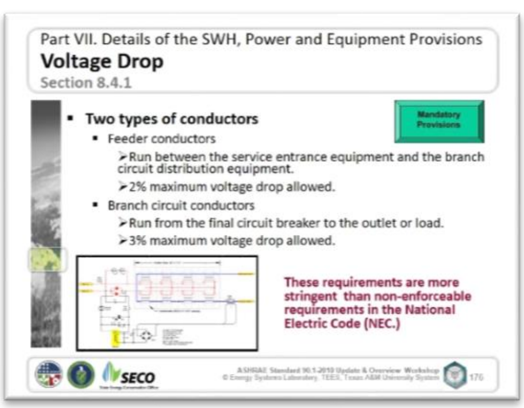
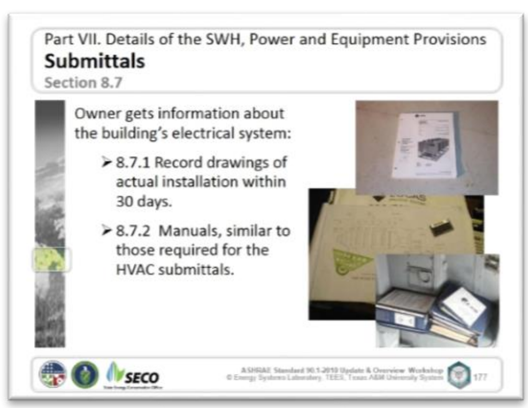
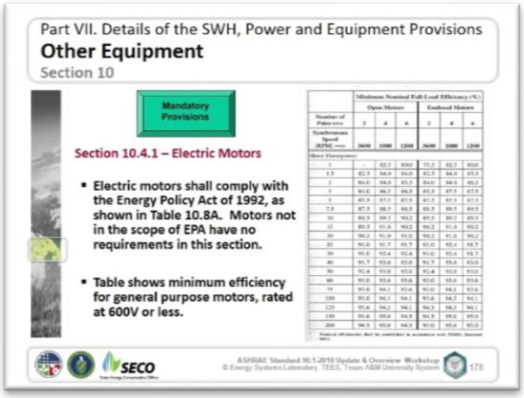


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)







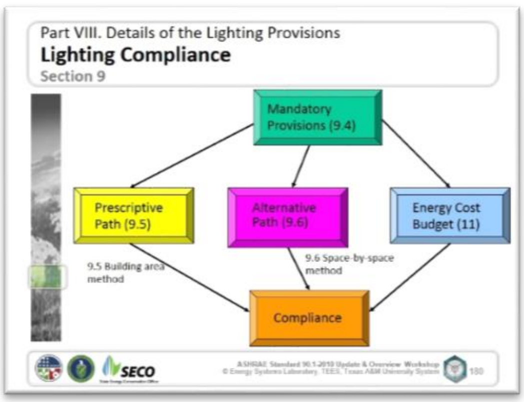
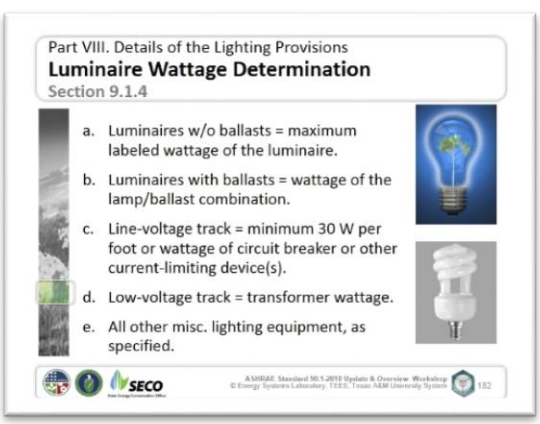
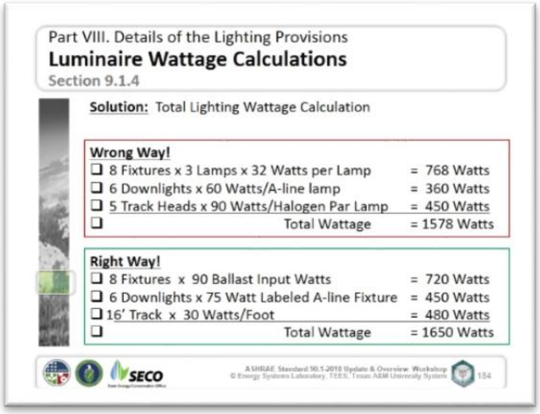
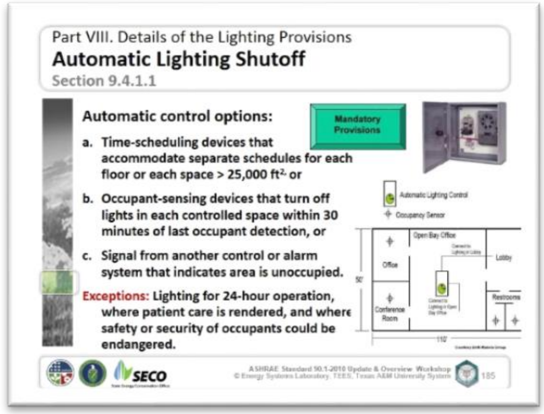
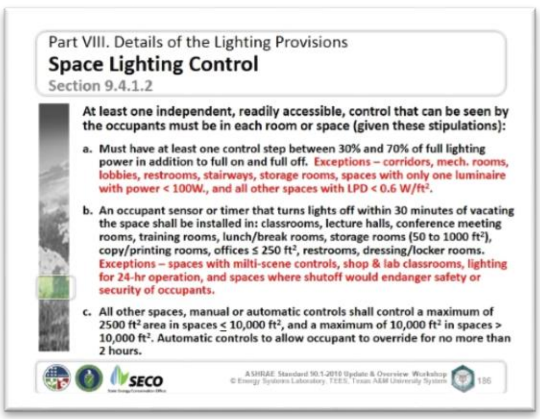


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









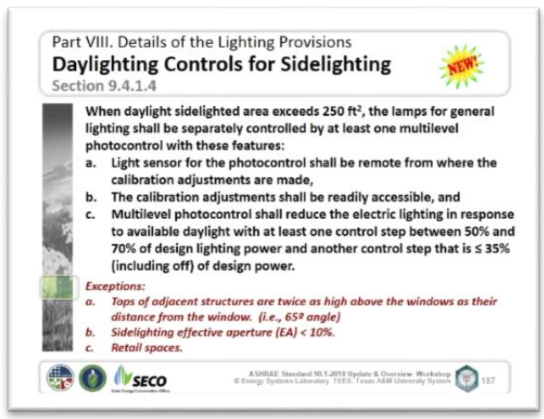
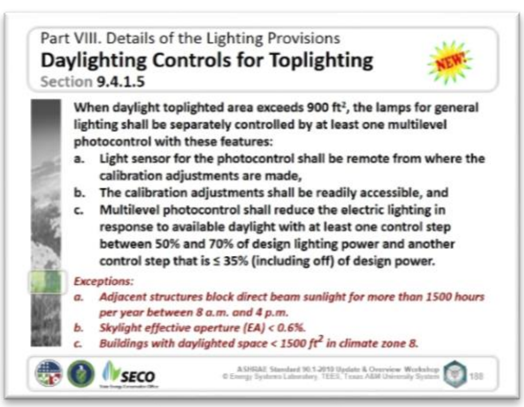
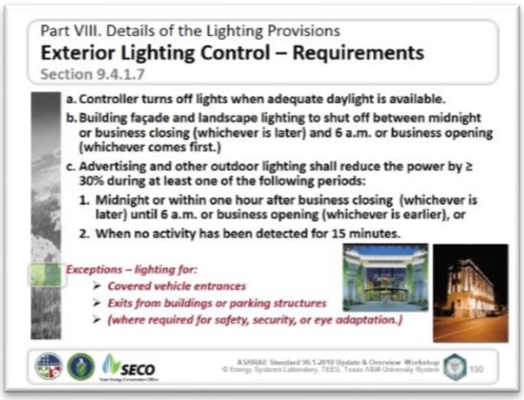
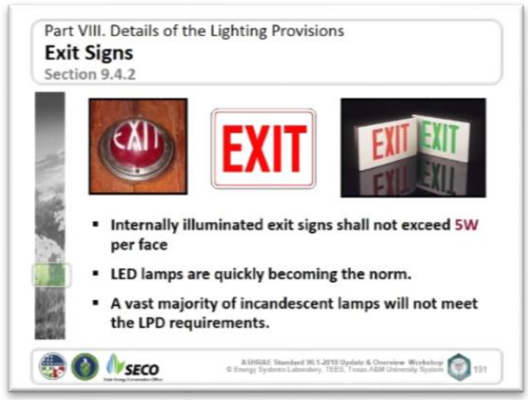
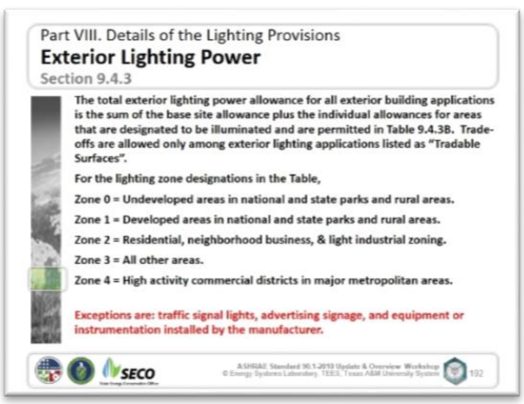


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









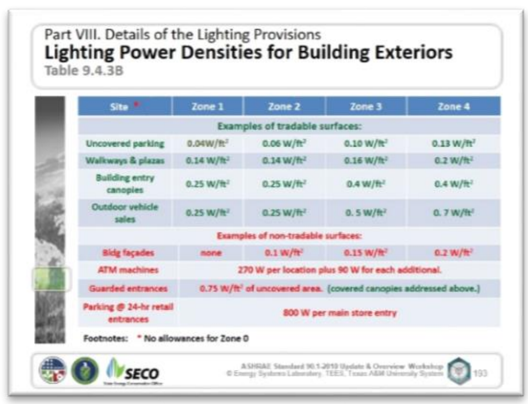
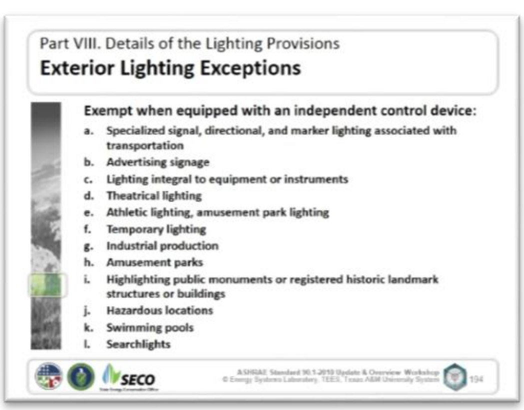
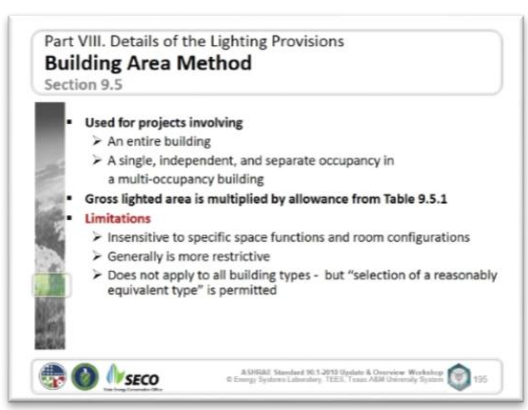


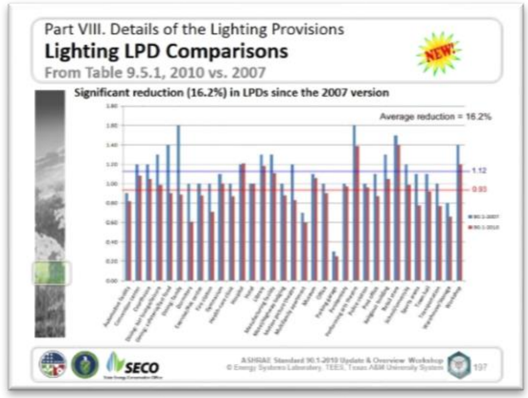
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)

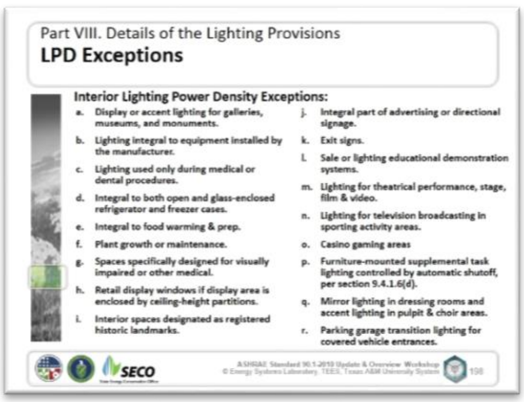




Lighting Power Densities (LPD), W/ft² – Building Area Method

Bldg Type	2007	2010	Diff.	Bldg Type	2007	2010	Diff.
Automotive facility	0.9	0.82	9 %	Multifamily	0.7	0.60	14 %
Convention center	1.2	1.08	10 %	Museum	1.1	1.06	4 %
Courthouse	1.2	1.05	13 %	Office	1.0	0.90	10 %
Dining: bar/lounge	1.3	0.99	24 %	Parking garage	0.3	0.25	17 %
Dining: cafeteria	1.4	0.90	36 %	Penitentiary	1.0	0.97	3 %
Dining: family	1.6	0.89	44 %	Performing arts theater	1.6	1.39	13 %
Dormitory	1.0	0.61	39 %	Police station	1.0	0.96	4 %
Exercise center	1.0	0.88	12 %	Post office	1.1	0.87	21 %
Fire station	1.0	0.71	29 %	Religious building	1.3	1.05	19 %
Gymnasium	1.1	1 %	9 %	Retail	1.5	1.40	7 %
Health-care clinic	1.0	0.87	13 %	School / University	1.2	0.99	18 %
Hospital	1.2	1.21	-1 %	Sports arena	1.1	0.78	29 %
Hotel	1.0	1.00	0 %	Town hall	1.1	0.92	16 %
Library	1.3	1.18	9 %	Transportation	1.0	0.77	23 %
Manufacturing facility	1.3	1.11	15 %	Warehouse	0.8	0.66	18 %
Motel	1.0	0.88	12 %	Workshop	1.4	1.20	14 %
Motion picture theatre	1.2	0.83	31 %	Overall Average	1.12	0.93	16.2 %





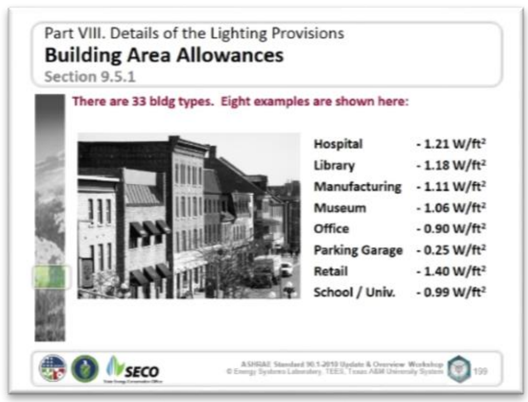
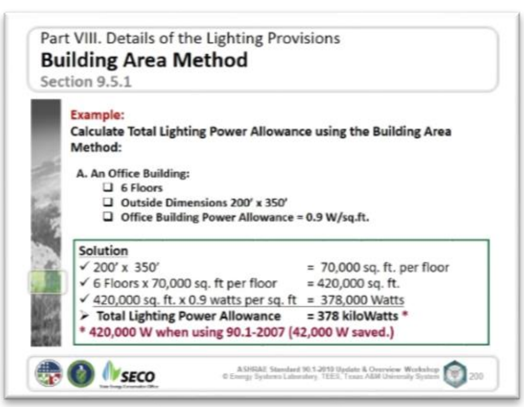
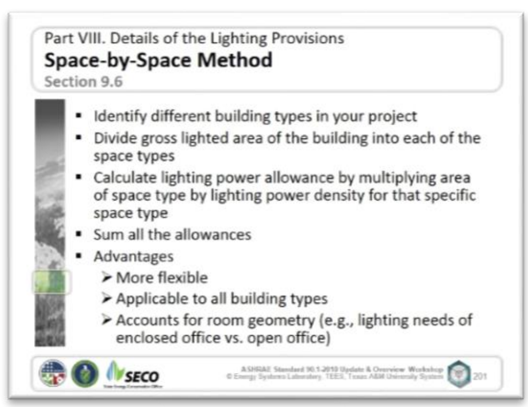


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)





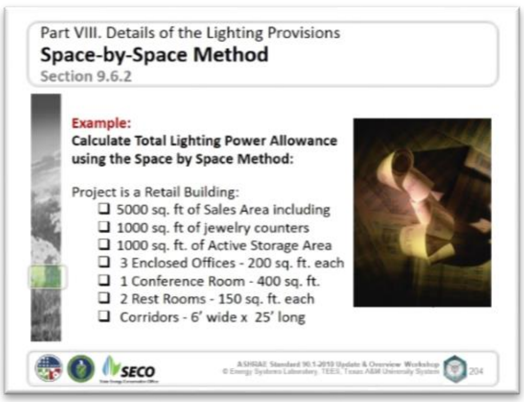
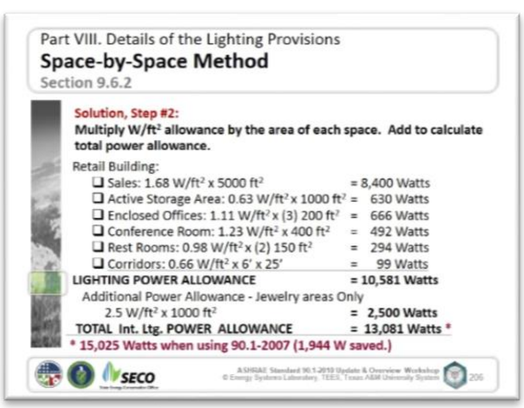
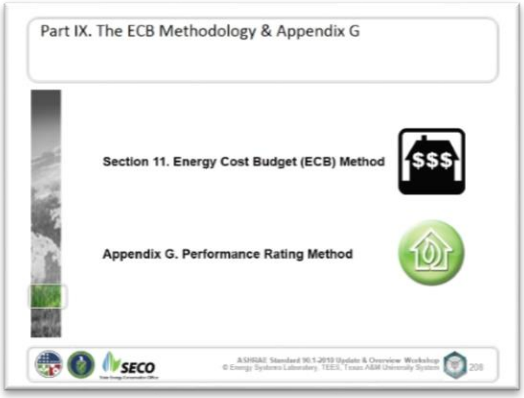
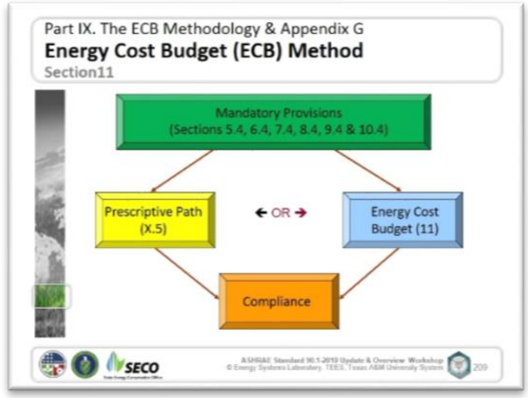
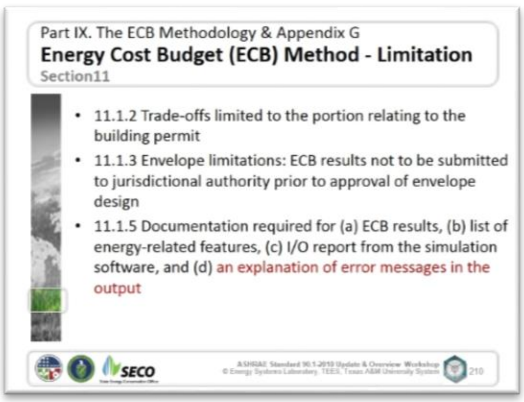


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









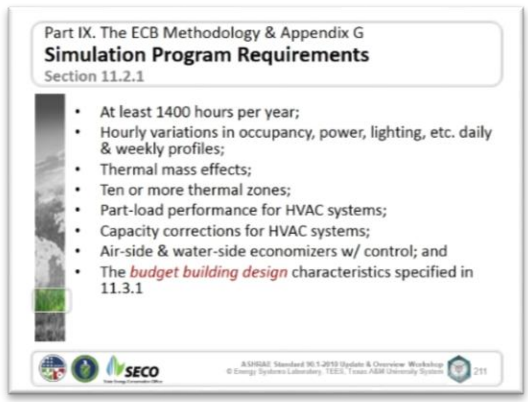
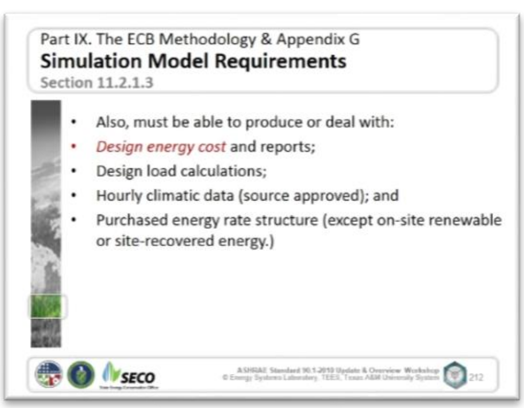
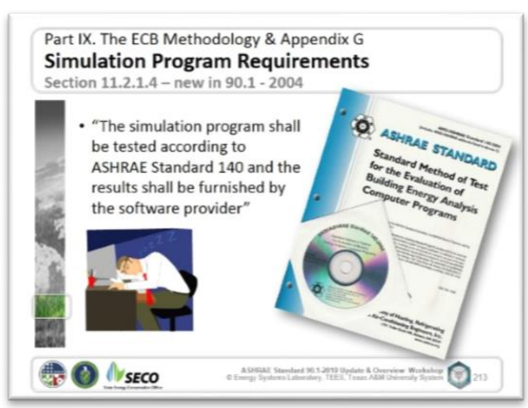
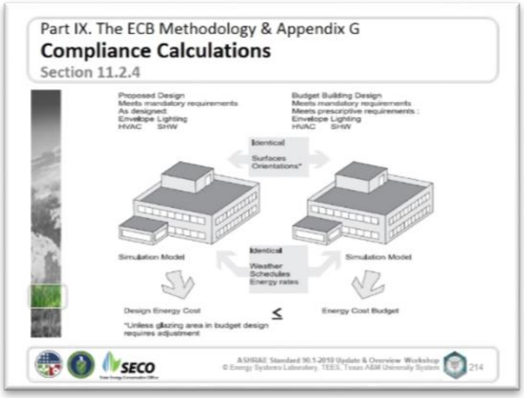
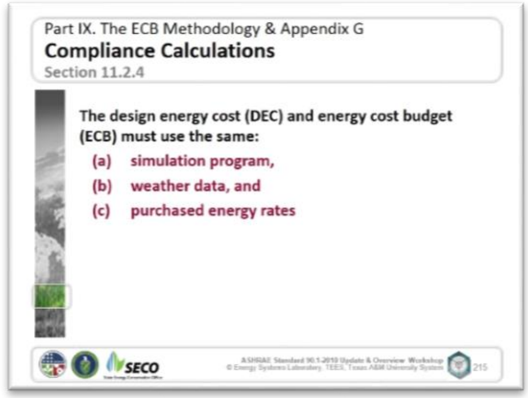


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









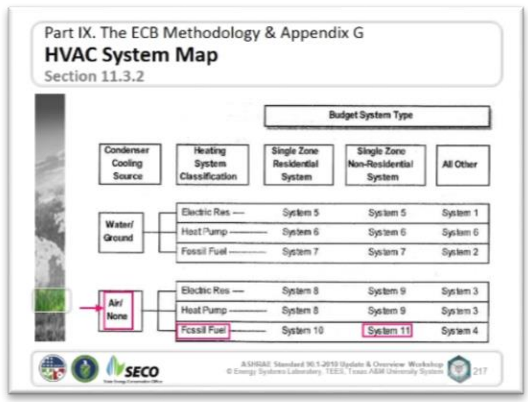
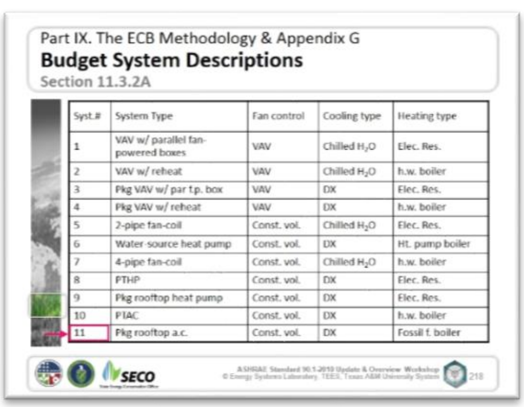
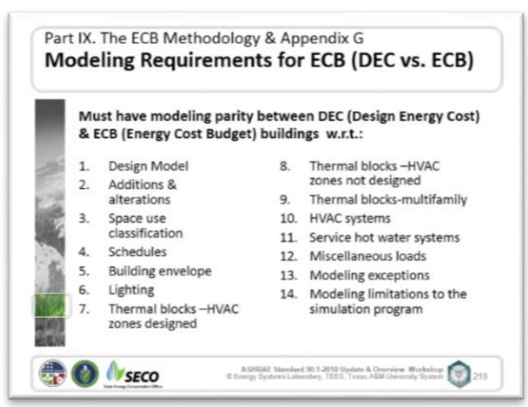
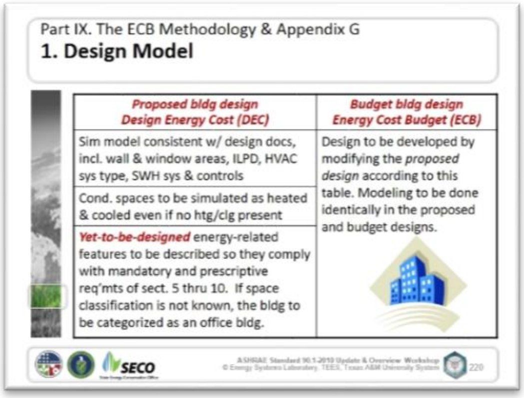


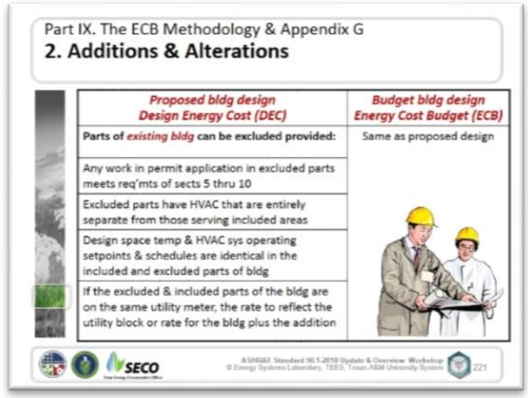
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)

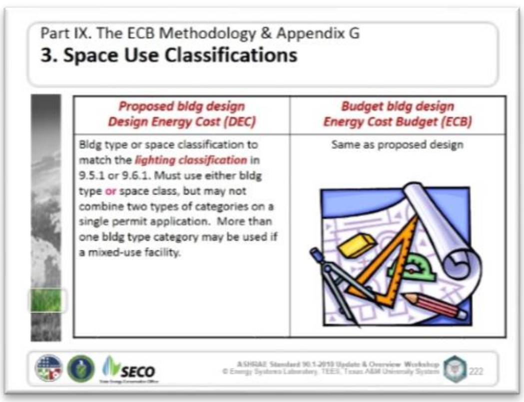


Syst.#	System Type	Fan control	Cooling type	Heating type
1	VAV w/ parallel fan-powered boxes	VAV	Chilled H_2O	Elec. Res.
2	VAV w/ reheat	VAV	Chilled H_2O	h.w. boiler
3	Pkg VAV w/ par f.p. box	VAV	DX	Elec. Res.
4	Pkg VAV w/ reheat	VAV	DX	h.w. boiler
5	2-pipe fan-coil	Const. vol.	Chilled H_2O	Elec. Res.
6	Water-source heat pump	Const. vol.	DX	Ht. pump boiler
7	4-pipe fan-coil	Const. vol.	Chilled H_2O	h.w. boiler
8	PTHP	Const. vol.	DX	Elec. Res.
9	Pkg rooftop heat pump	Const. vol.	DX	Elec. Res.
10	PTAC	Const. vol.	DX	h.w. boiler
11	Pkg rooftop a.c.	Const. vol.	DX	Fossil f. boiler









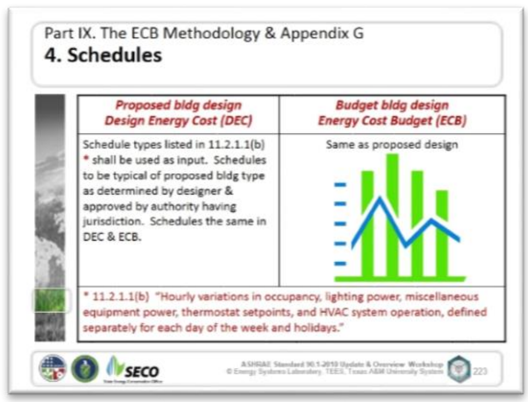
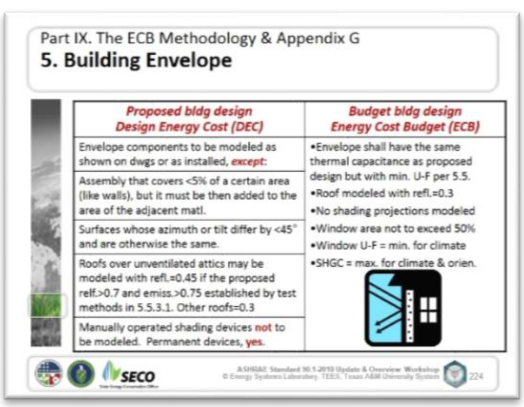
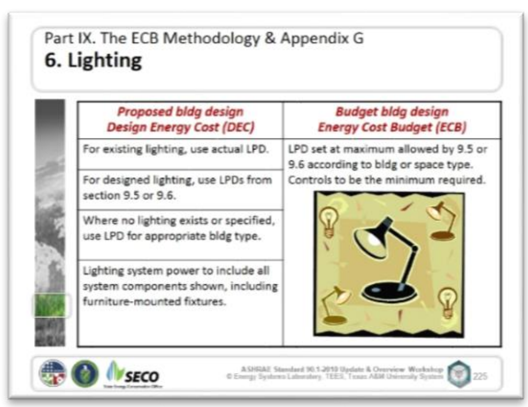
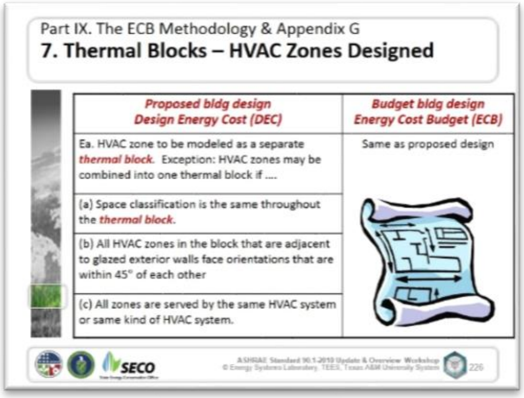
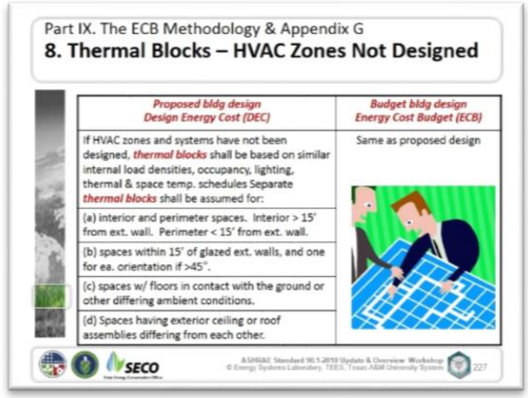


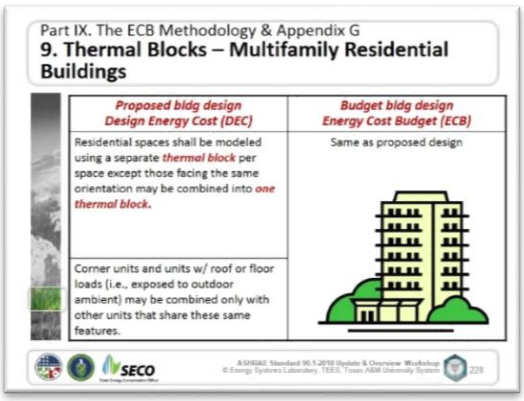
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











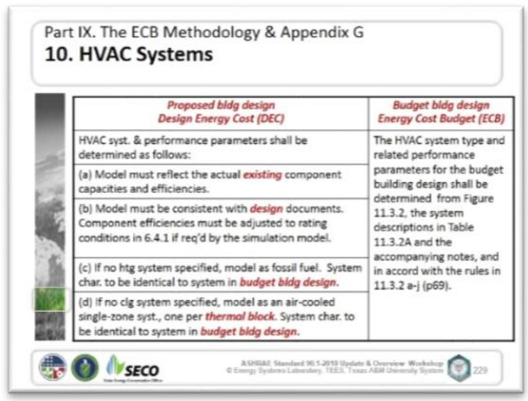
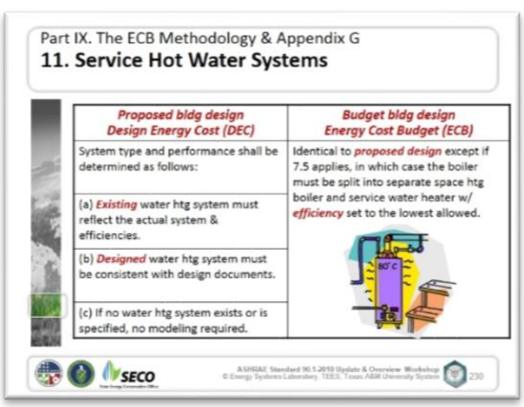
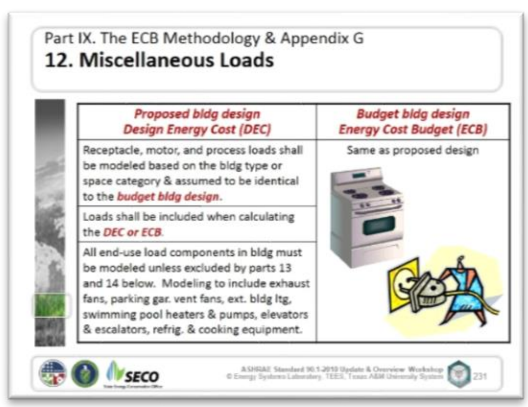
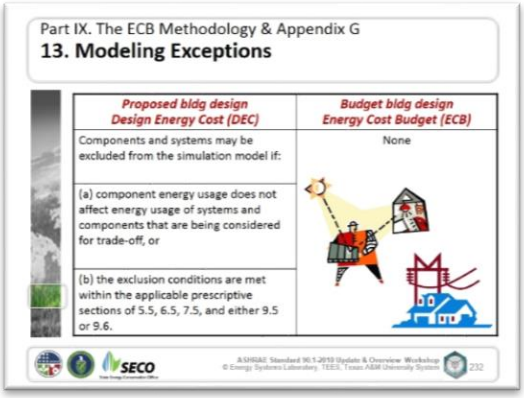
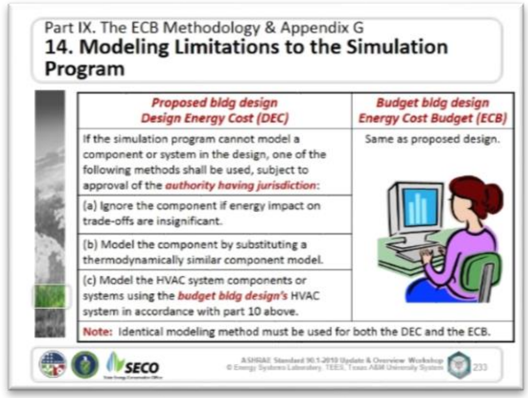


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









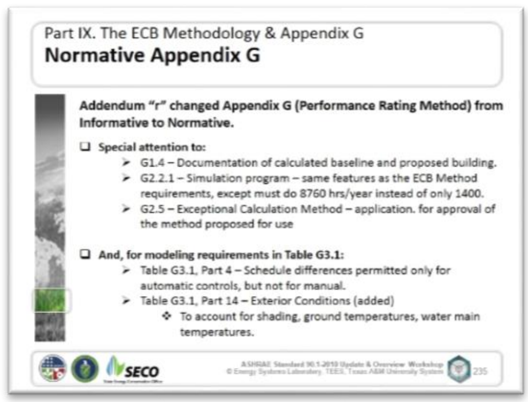
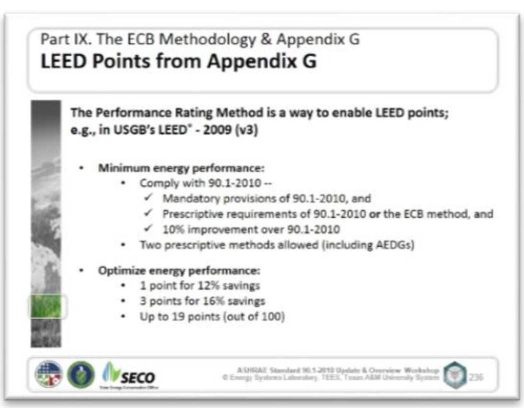
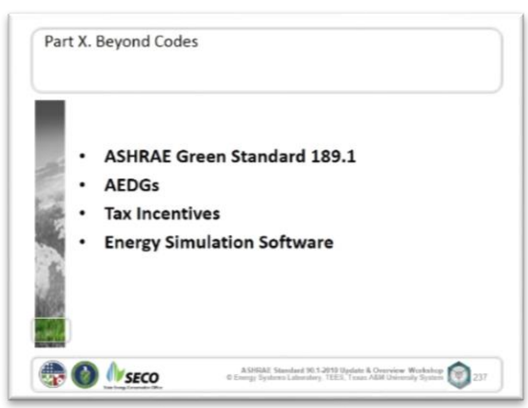
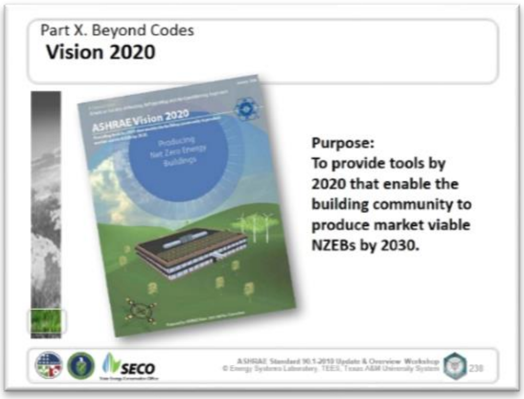


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)







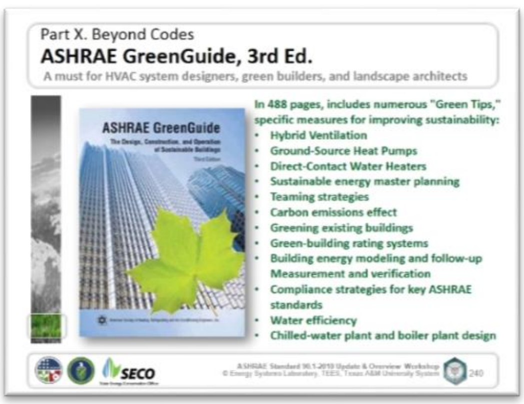
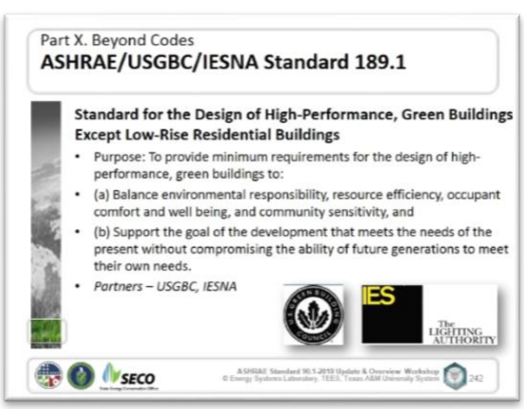
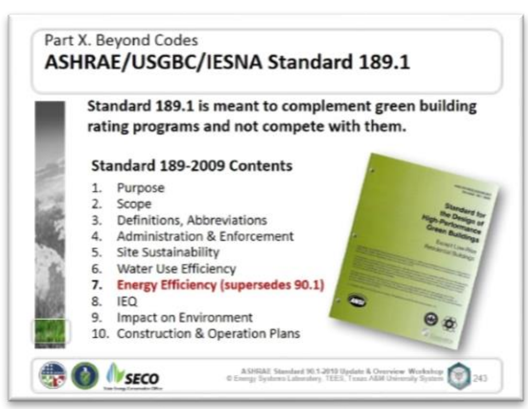
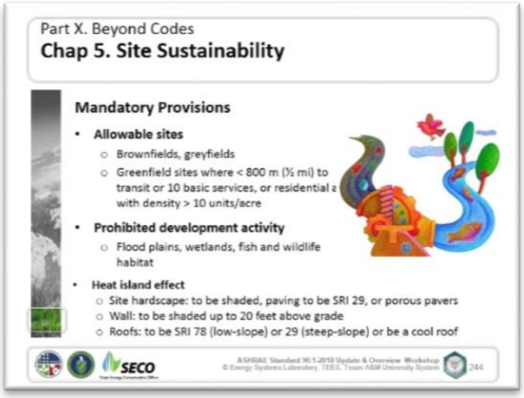
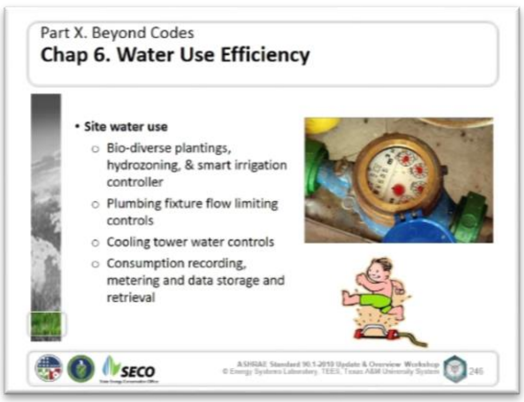


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









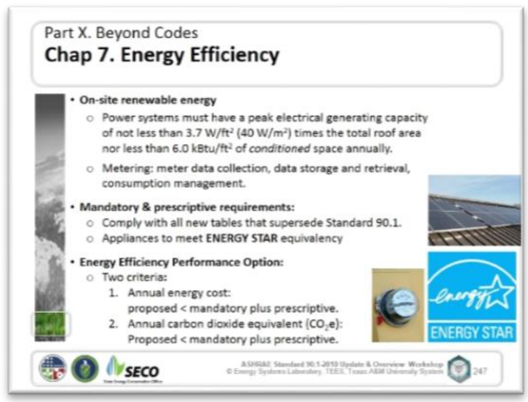
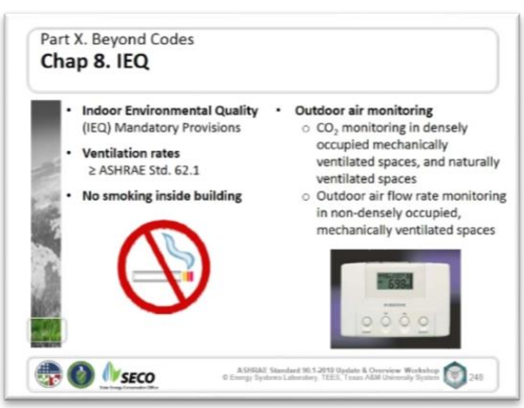
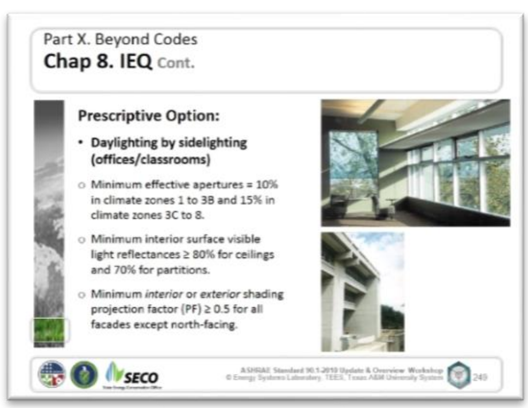
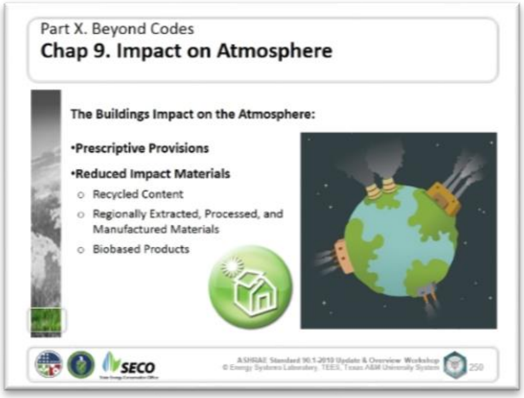
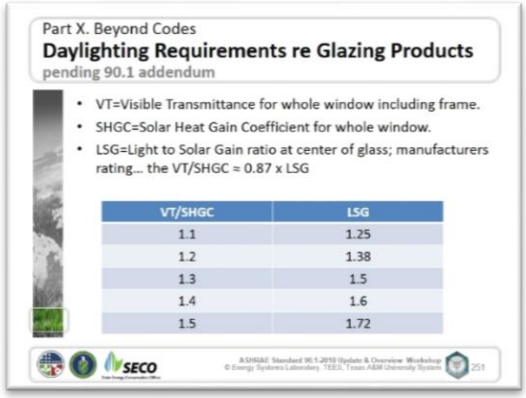


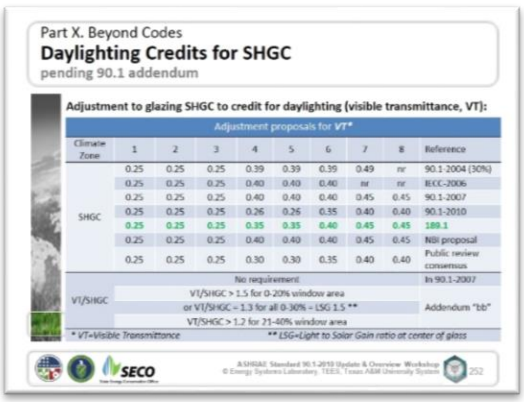
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)











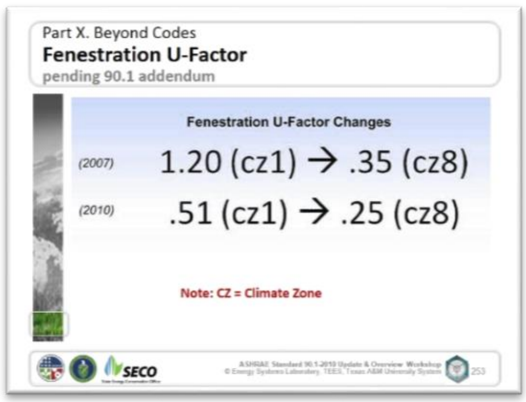
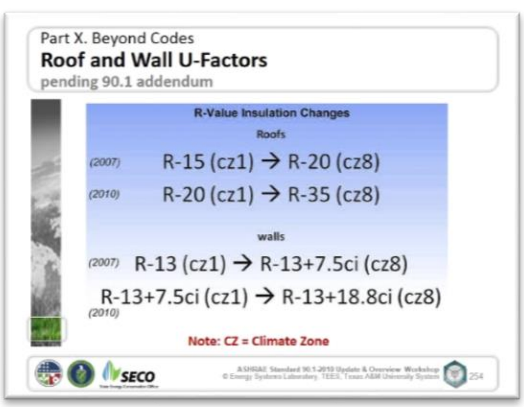
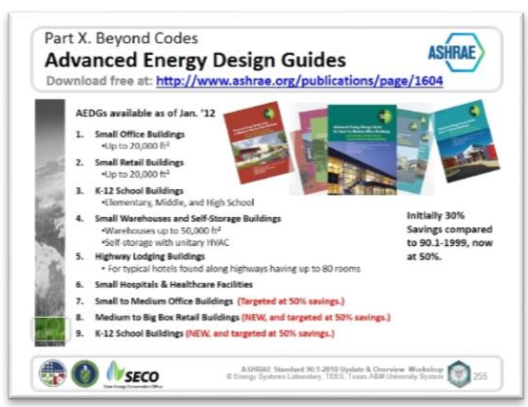
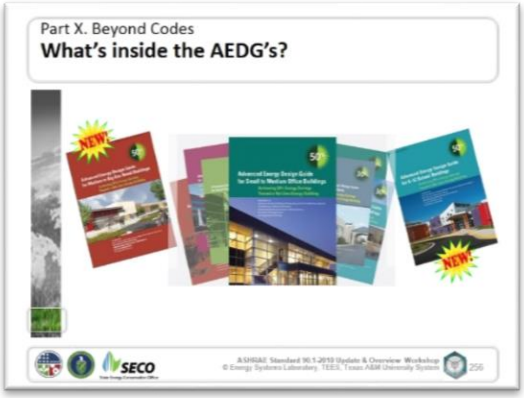
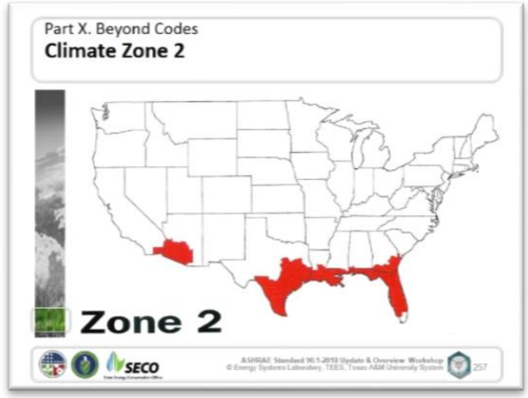


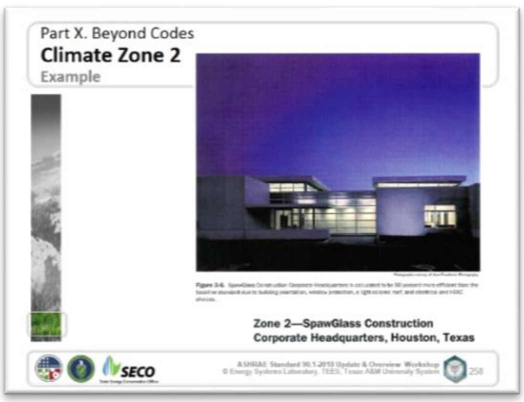
Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)

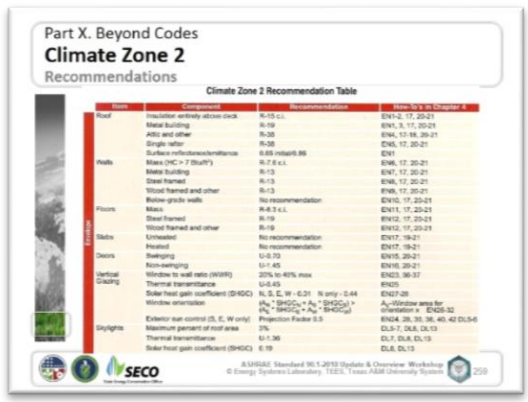








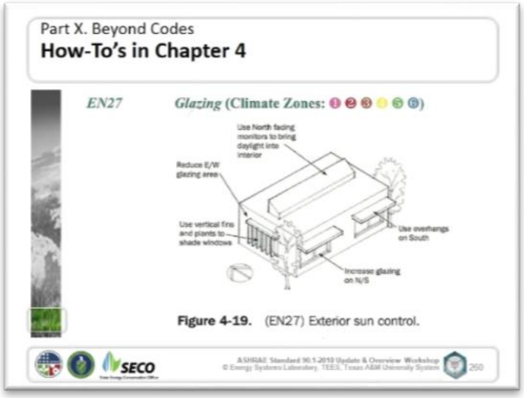


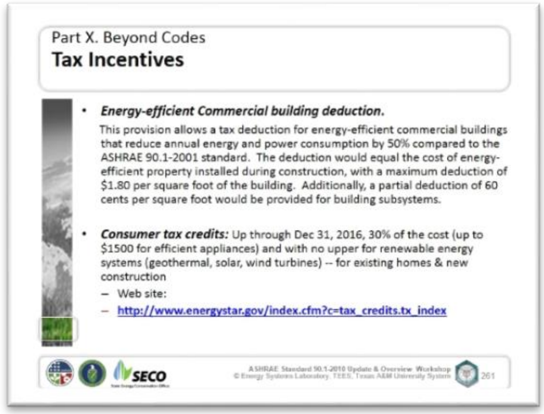


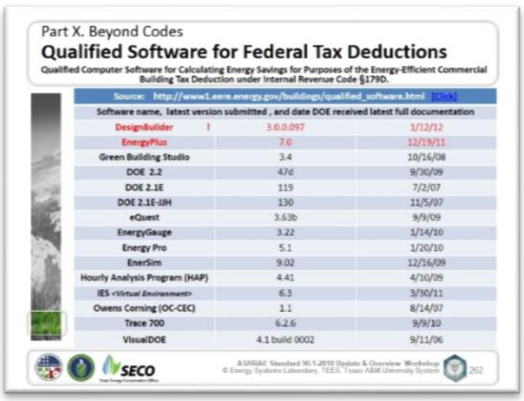
Climate Zone 2 Recommendation Table

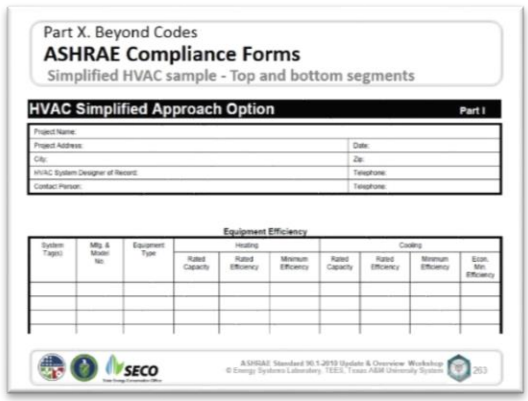
Item	Component	Recommendation	How-To's in Chapter 4
Roof	Insulation entirely above deck	R-15 c.i.	EN1-2, 17, 20-21
	Metal building	R-19	EN1, 3, 17, 20-21
	Attic and other	R-38	EN4, 17-18, 20-21
	Single rafter	R-38	EN5, 17, 20-21
	Surface reflectance/emittance	0.65 initial/0.86	EN1
Walls	Mass (HC > 7 Btu/ft²)	R-7.6 c.i.	EN6, 17, 20-21
	Metal building	R-13	EN7, 17, 20-21
	Steel framed	R-13	EN8, 17, 20-21
	Wood framed and other	R-13	EN9, 17, 20-21
	Below-grade walls	No recommendation	EN10, 17, 20-21
Floors	Mass	R-8.3 c.i.	EN11, 17, 20-21
	Steel framed	R-19	EN12, 17, 20-21
	Wood framed and other	R-19	EN12, 17, 20-21
Slabs	Unheated	No recommendation	EN17, 19-21
	Heated	No recommendation	EN17, 19-21
Doors	Swinging	U-0.70	EN15, 20-21
	Non-swinging	U-1.45	EN16, 20-21
Vertical Glazing	Window to wall ratio (WWR)	20% to 40% max	EN23, 36-37
	Thermal transmittance	U-0.45	EN25
	Solar heat gain coefficient (SHGC)	N, S, E, W - 0.31 N only - 0.44	EN27-28
	Window orientation	$(A_N * SHGC_N + A_S * SHGC_S) > (A_E * SHGC_E + A_W * SHGC_W)$	A_X—Window area for orientation x EN26-32
	Exterior sun control (S, E, W only)	Projection Factor 0.5	EN24, 28, 30, 36, 40, 42 DL5-6
Skylights	Maximum percent of roof area	3%	DL5-7, DL8, DL13
	Thermal transmittance	U-1.36	DL7, DL8, DL13
	Solar heat gain coefficient (SHGC)	0.19	DL8, DL13

Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)









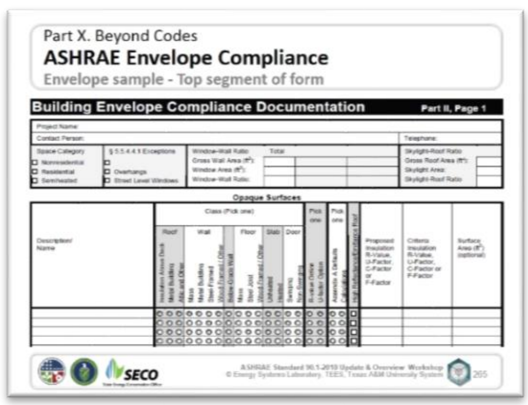
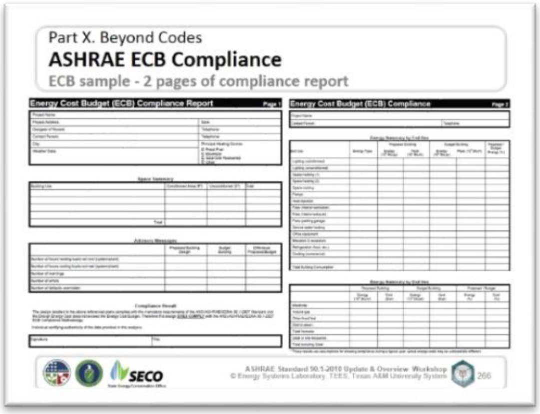
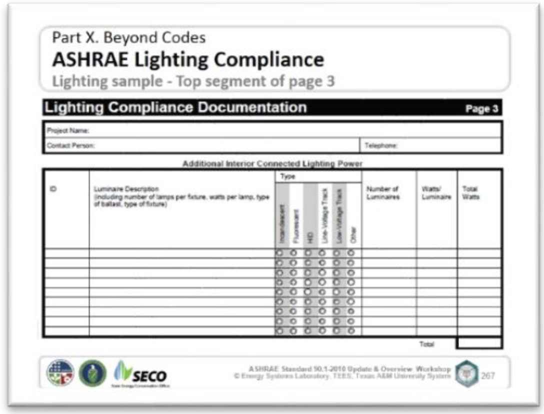
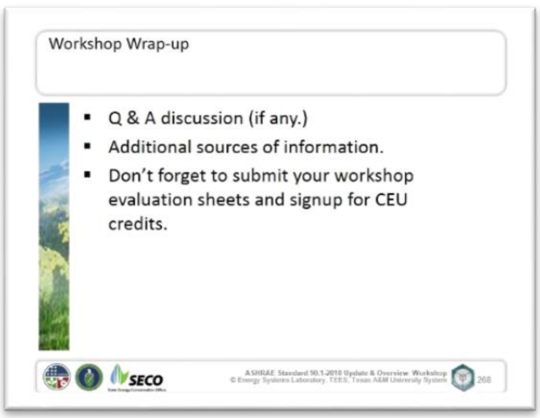


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)







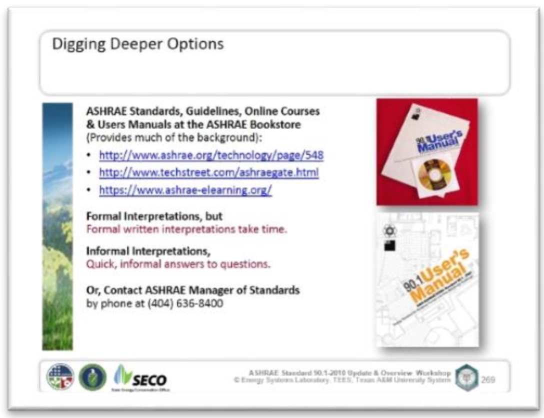
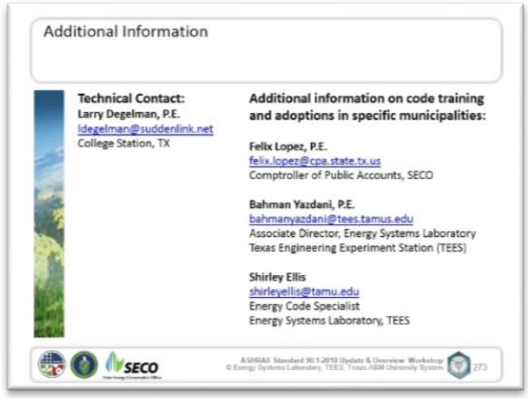


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)



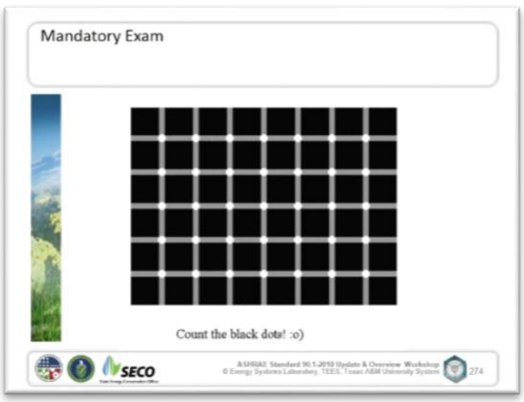


Figure 24: ASHRAE 90.1 Standard Update Workshop (continued)

1.10 Evaluation of Additional Technologies for Reducing Energy Use in Existing Buildings

The Laboratory provided technical assistance to the TCEQ, the PUCT, SECO and ERCOT, as well as Stakeholders participating in the Energy Code and Renewables programs.

- In 2008, the Laboratory continued to work with the TCEQ to develop an integrated NOx emissions reductions calculation that provided the TCEQ with a creditable NOx emissions reductions from energy efficiency and renewable energy (EE/RE) programs reported to the TCEQ in 2008 by the Laboratory, PUCT, SECO, and ERCOT (i.e., wind).
- At the request of the TCEQ, the Laboratory has continued the development of procedures for quantifying NOx emissions reductions from wind turbines that includes weather normalization and the quantification of NOx emissions reductions from the new Federal regulations for SEER 13 air conditioners.

1.11 Planned Focus for 2013

In FY 2013, the Energy Systems Laboratory will continue in its cooperative efforts with the TCEQ, PUCT, SECO, US EPA and others to evaluate the energy savings resulted from the EE/RE measures and programs of the TERP and their impact on air quality, and continue with the energy code state-wide implementation assistance under the Texas Building Energy Performance Standards program of the TERP. The Laboratory team will:

- Assist the TCEQ to obtain SIP credits from energy efficiency and renewable energy using the Laboratory's Emissions Reduction Calculator technology;
- Verify, document and report energy efficiency and renewable energy savings in all TERP EE/RE programs for the SIP in each non-attainment and affected county using the TCEQ/US EPA approved technology;
- Assist the PUCT with determining emissions reductions credits from energy efficiency programs funded by SB 7 and SB 5;
- Assist political subdivisions and Councils of Governments with calculating emissions reductions from local code changes and voluntary EE/RE programs for SIP inclusion;
- Continue to refine the cost-effective techniques to implement 15% above code (2009 IECC) energy efficiency in low-priced and moderately-priced residential housing;
- Continue to refine the cost-effective methods and techniques to implement 15% above code energy efficiency in low-priced and moderately-priced commercial buildings;
- Continue to develop creditable procedures for calculating NOx emissions reductions from green renewable technologies, including wind power, solar energy and geothermal energy systems;
- Continue development of well-documented, integrated NOx emissions reductions methodologies for calculating and reporting NOx reductions, including a unified database framework for required reporting to TCEQ of potentially creditable measures from the ESL, PUCT, and SECO SB 5 initiatives;
- Upon request, provide written recommendations to the State Energy Conservation Office (SECO) about whether or not the energy efficiency provisions of latest published edition of the International Residential Code (IRC), or the International Energy Conservation Code (IECC), are equivalent to, or better than, the energy efficiency and air quality achievable under the editions adopted under the 2001 IRC/IECC. This will consider comments made by persons who have an interest in the adoption of the energy codes in the recommendations made to SECO.
- Develop a standardized report format to be used by providers of home energy ratings, including different report formats for rating newly constructed residences from those for existing residences.
- Continue to cooperate with an industry organization or trade association to: develop guidelines for home energy ratings; provide training for individuals performing home energy ratings and providers of home energy ratings; and provide a registry of completed ratings for newly constructed residences and residential improvement projects for the purpose of computing the energy savings and emissions reductions benefits of the home energy ratings program.
- Include all benefits attained from this program in an annual report to the commission.
- Enhance IC3 to support multifamily residences, and add other features to enhance adoption.

- Engage production builders and municipalities in overcoming obstacles to their using IC3 for their new home construction.
- Seek funding to enhance TCV IC3. Assist SECO in refining the form on which political subdivisions need to report annually their electric consumption.
- Assist SECO in developing a new standardized reporting form for all municipally owned utilities and electric cooperatives, which had retail sales of more than 500,000 MWh in 2005, to report the combined effects of their energy efficiency activities from the previous calendar year.
- Send a representative to SECO's new advisory committee for selecting high-performance building design evaluation systems.

The Laboratory has and will continue to provide leading-edge technical assistance to counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering emissions and improving the air for all Texans. The Laboratory will continue to provide superior technology to the State of Texas through efforts with the TCEQ and US EPA. The efforts taken by the Laboratory have produced significant success in bringing EE/RE closer to US EPA acceptance in the SIP.

If any questions arise, please contact us by phone at 979-845-1280, or by email at terpinfo@tees.tamus.edu.

2. Introduction

2.1 Background

In 2001, the Texas Legislature adopted the Texas Emissions Reduction Plan, identifying thirty-eight counties in Texas where a focus on air quality improvements was deemed critical to public health and economic growth. These areas are shown on the map in Figure 25 as non-attainment and near nonattainment. In 2008, the twenty counties designated as nonattainment counties include: Brazoria, Chambers, Collin, Dallas, Denton, Ellis, Fort Bend, Hardin, Harris, Jefferson, Galveston, Johnson, Kaufman, Liberty, Montgomery, Orange, Parker, Rockwall, Tarrant, and Waller Counties. The fourteen counties designated as Ozone Early Action Compact counties include: Bastrop, Bexar, Caldwell, Comal, Gregg, Guadalupe, Harrison, Hays, Rusk, Smith, Travis, Upshur, Williamson, and Wilson County.

These counties represent several geographic areas of the state, which have been assigned to different climate zones by the 2001 IECC[8] as shown in Figure 26, based primarily on Heating Degree Days (HDD). These include climate zone 5 or 6 (i.e., 2,000 to 2,999 HDD_{65}) for the Dallas-Ft. Worth and El Paso areas, and climate zones 3 and 4 (i.e., 1,000 to 1,999 HDD_{65}) for the Houston-Galveston-Beaumont-Port Arthur-Brazoria areas. Also shown in Figure 26 are the locations of the various weather data sources, including the Typical Meteorological Year (TMY2) (NREL 1995) stations, the Weather Year for Energy Calculations (WYEC2) (Stoffel 1995) weather stations, the National Weather Service weather stations, (NWS) (NOAA 1993) weather stations, the ASHRAE 90.1 1989 weather locations[9], the ASHRAE 90.1 1999 weather locations, the solar stations measured by the National Renewable Energy Laboratory (NREL)[10], the solar stations measured by the TCEQ[11], and F-CHART and PV F-CHART weather locations[12].

[8] The "2000 IECC" notation is used to signify the 2000 International Residential Code (IRC), which includes the International Energy Conservation Code (IECC) as modified by the 2001 Supplement (IECC 2001), published by the ICC in March of 2001, as required by Senate Bill 5.
[9] The ASHRAE 90.1-1989 and 90.1-1999 weather stations are used in the emissions calculator for determining the building characteristics.
[10] The NREL stations were the primary source of the 1999 global horizontal, direct normal and diffuse solar radiation used to determine the 1999 peak-day and annual emissions for the DOE-2 simulations for code-compliant housing and commercial buildings.
[11] The TCEQ stations were used as the secondary source for global horizontal solar radiation when the NREL sites were missing data or no NREL site was nearby.
[12] The F-Chart and PV F-Chart weather locations are used to determine the solar thermal or electricity produced by the systems specified by the use in the emissions calculation. The monthly energy or electricity production from F-Chart or PV F-Chart is then weather-normalized using

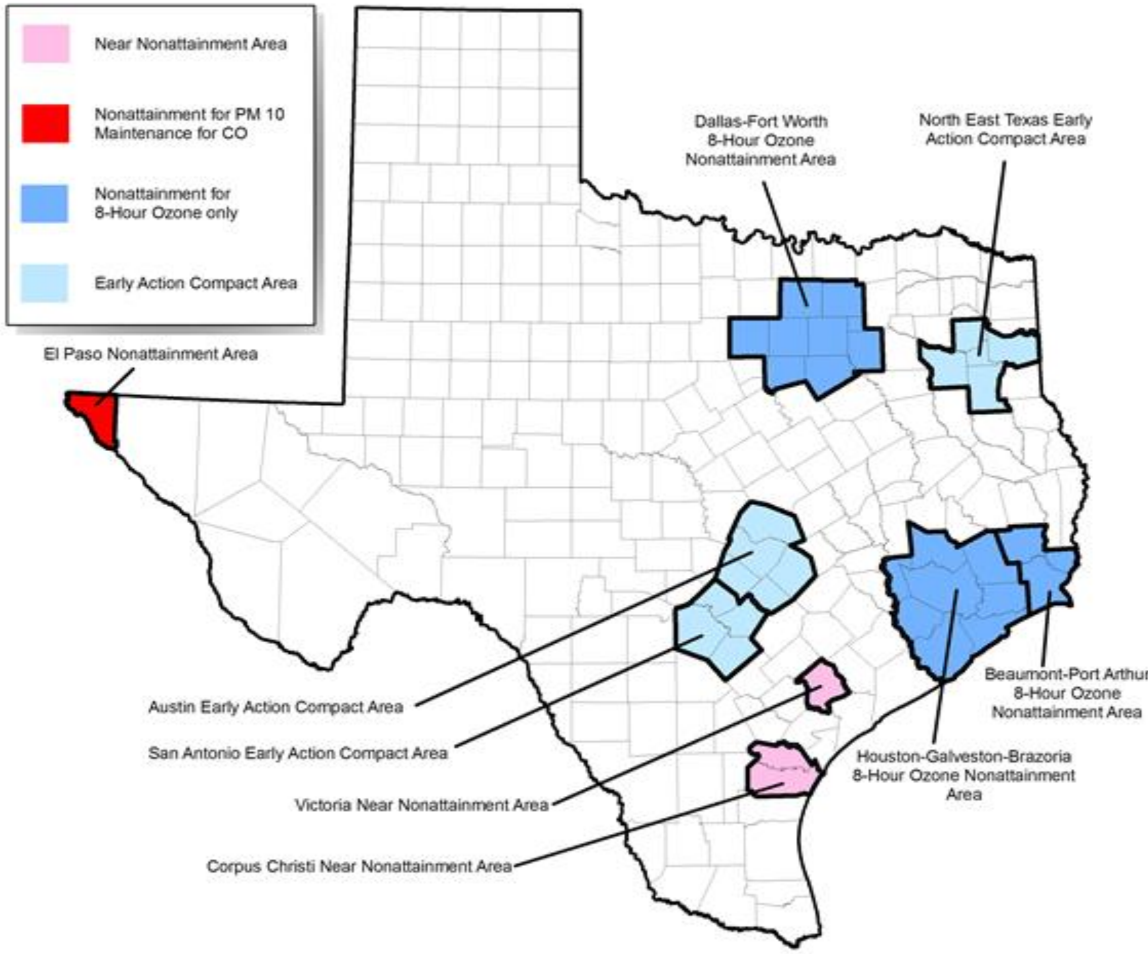


Figure 25: US EPA Nonattainment and Near Nonattainment

2.2 Energy Systems Laboratory's Responsibilities in the TERP

In 2001, Texas Senate Bill 5 outlined the following responsibilities for the Energy Systems Laboratory (ESL) within the TERP:

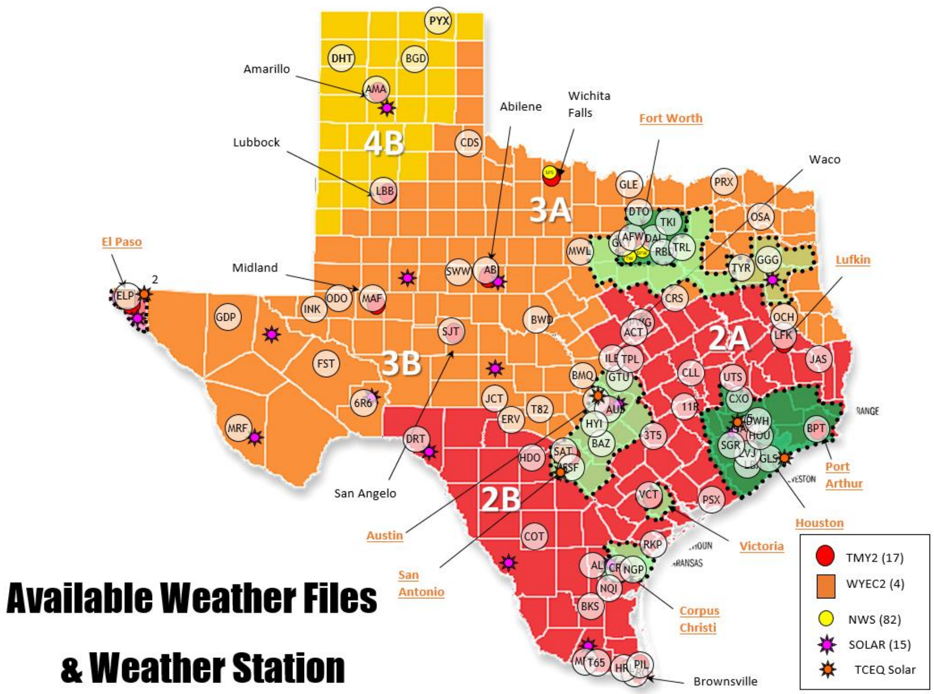
- Sec. 386.205. Evaluation of State Energy Efficiency Programs.
- Sec. 388.003. Adoption of Building Energy Efficiency Performance Standards.
- Sec. 388.004. Enforcement of Energy Standards Outside of Municipality.
- Sec. 388.007. Distribution of Information and Technical Assistance.
- Sec. 388.008. Development of Home Energy Ratings.

In 2003 these responsibilities were modified by the following:

- House Bill 1365, including modifications to:
  - Sec. 388.004. Enforcement of Energy Standards Outside of Municipality
  - Sec. 388.009. Energy-Efficient Building Program
- House Bill 3235 which includes modifications to

ASHRAE's Inverse Model Toolkit to develop coefficients that are then used to determine the 1999 annual and peak day energy or electricity production for emissions calculations.

- Sec. 388.009. Certification of Municipal Building Inspectors.



List of Available Weather Files and Weather Stations of Texas

Texas Weather Stations (NOAA)

1 Abilene Regional Airport (ABI)
2 Alice International Airport (ALI)
3 Amarillo International Airport (AMA)
4 Angleton / Lake Jackson Brazori (LBX)
5 Arlington Municipal Airport (GKY)
6 Austin - Bergstrom International (AUS)
7 Austin Camp Mabry (ATT)
8 Borger Hutchinson County Airport (BGD)
9 BRENHAM: BRENHAM MUNICIPAL AIRPORT (11R)
10 Brownsville S Padre Isl International (BRO)
11 BROWNWOOD: BROWNWOOD REGIONAL AIRPORT (BWD)
12 Burnet Municipal Airport (BMQ)
13 Childress Municipal Airport (CDS)
14 College Station (CLL)
15 Conroe Montgomery County Airport (CXO)
16 Corpus Christi International Airport (CRP)
17 CORPUS CHRISTI: CORPUS CHRISTI NAS/TRUAX FIELD ARPT (NGP)
18 Corsicana Campbell Field (CRS)
19 Cotulla La Salle Co Airport (COT)
20 Dalhart Municipal Airport (DHT)
21 Dallas - Fort Worth International Airport (DFW)
22 Dallas Love Field (DAL)
23 Dallas Redbird Airport (RBD)
24 Del Rio International Airport (DRT)
25 Denton Municipal Airport (DTO)
26 Dryden Terrell County Airport (6R6)
27 El Paso International Airport (ELP)
28 FALFURRIAS: BROOKS COUNTY AIRPORT (BKS)
29 Fort Stockton Pecos County Airport (FST)
30 Fort Worth Alliance Airport (AFW)
31 Fort Worth Meacham (FTW)
32 FREDERICKSBURG: GILLESPIE COUNTY AIRPORT (T82)
33 GAINESVILLE: GAINESVILLE MUNICIPAL AIRPORT (GLE)
34 Galveston Scholes Field (GLS)
35 GEORGETOWN: GEORGETOWN MUNICIPAL AIRPORT (GTU)
36 Harlingen Rio Grande Valley I (HRL)
37 Hondo Municipal Airport (HDO)
38 Houston Bush Intercontinental (IAH)
39 Houston Clover Field (LVJ)
40 Houston Hooks Memorial Airport (DWH)
41 Houston Sugarland Mem (SGR)
42 Houston William P Hobby Airport (HOU)
43 Huntsville Municipal Airport (UTS)
44 JASPER: JASPER COUNTY-BELL FIELD AIRPORT (JAS)
45 Junction Kimble County Airport (JCT)
46 KERRVILLE: KERRVILLE MUNI/LOUIS SCHREINER FLD AIRPORT (ERV)
47 KILLEEN: KILLEEN MUNICIPAL AIRPORT (ILE)
48 KINGSVILLE: KINGSVILLE NAS AIRPORT (NQI)
49 LA GRANGE: FAYETTE REGIONAL AIR CENTER AIRPORT (3T5)
50 Longview E Tx Rgnl Airport (GGG)
51 Lubbock International Airport (LBB)
52 Lufkin Angelina Cty Airport (LFK)
53 MARFA: MARFA MUNICIPAL AIRPORT (MRF)
54 McAllen Miller International Airport (MFE)
55 McKinney Municipal Airport (TKI)
56 Midland International Airport (MAF)
57 Mineral Wells Airport (MWL)
58 MOUNT PLEASANT: MOUNT PLEASANT REGIONAL AIRPORT (OSA)
59 NACOGDOCHES: A L MANGHAM JR REGIONAL AIRPORT (OCH)
60 New Braunfels Municipal Airport (BAZ)
61 Odessa Schlemeyer Field (ODO)
62 Palacios Municipal Airport (PSX)
63 PARIS: COX FIELD AIRPORT (PRX)
64 PERRYTON: PERRYTON OCHILTREE COUNTY AIRPORT (PYX)
65 Pine Springs Guadalupe Mounta (GDP)
66 Port Arthur Se Tx Rgnl Airport (BPT)
67 Port Isabel Cameron County Airport (PIL)
68 Rockport Aransas Co Airport (RKP)
69 San Angelo Mathis Field (SJT)
70 San Antonio International Airport (SAT)
71 San Antonio Stinson Municipal Airport (SSF)
72 SAN MARCOS: SAN MARCOS MUNICIPAL AIRPORT (HYI)
73 SWEETWATER: AVENGER FIELD AIRPORT (SWW)
74 TEMPLE: DRAUGHON-MILLER CNTRL TEXAS REGIONAL ARPT (TPL)
75 Terrell Municipal Airport (TRL)
76 Tyler Pounds Field (TYR)
77 Victoria Regional Airport (VCT)
78 WACO: MC GREGOR EXECUTIVE AIRPORT (PWG)
79 Waco Regional Airport (ACT)
80 WESLACO: MID VALLEY AIRPORT (T65)
81 Wichita Falls Municipal Airport (SPS)
82 Wink Winkler Co Airport (INK)

Texas TMY2 Weather Files

1 Abilene
2 Amarillo
3 Austin
4 Brownsville
5 Corpus Christi
6 El Paso
7 Fort Worth
8 Houston
9 Lubbock
10 Lufkin
11 Midland
12 Port Arthur
13 San Angelo
14 San Antonio
15 Victoria
16 Waco
17 Wichita Falls

Texas WYEC2 Weather Files

1 El Paso
2 Brownsville
3 Fort Worth
4 San Antonio

NREL Solar Stations

1 Abilene
2 Austin
3 Big Spring
4 Canyon
5 Clear Lake
6 Corpus Christi
7 Del Rio
8 Edinburg
9 El Paso
10 Laredo
11 Menard
12 Overton
13 Pecos
14 Presidio
15 Sanderson

TCEQ Solar Stations

1 Bexar
2 Travis
3 El Paso (2)
4 Galveston
5 Harris (5)

FCHART and PV FCHART (New Weather File)

1 ABILENE
2 AMARILLO
3 AUSTIN
4 BROWNSVILLE
5 CORPUS CHRISTI
6 EL PASO
7 FORT WORTH
8 HOUSTON
9 LUBBOCK
10 LUFKIN
11 MIDLAND-ODESSA
12 PORT ARTHUR
13 SAN ANGELO
14 SAN ANTONIO
15 SHERMAN
16 VICTORIA
17 WACO
18 WICHITA FALLS

Figure 26: Available NWS, TMY2 and WYEC2 weather files compared to IECC/IRC weather zones for Texas

In 2005 these same responsibilities were further updated:

- with Senate Bill 20, House Bill 2481, and 2129.

These responsibilities were further updated in 2007:

- with Senate Bill 12 and House Bill 3693.

These responsibilities were further updated in 2009:

- with House Bill 1796.

These responsibilities were further updated in 2011:

- with Senate Bills 898 and 924, and House Bill 51.

These responsibilities were not updated in 2012.

In the following sections each of these tasks is further described.

2.2.1 (SB 5) Section 386.205. Evaluation of State Energy Efficiency Programs (w/PUCT)

The Laboratory is instructed to assist the Public Utility Commission of Texas (PUCT) and provide an annual report that quantifies by county the reductions of energy demand, peak loads, and associated emissions of air contaminants achieved from the programs implemented under this subchapter and from those implemented under Section 39.905, Utilities Code (i.e., Senate Bill 7).

2.2.2 (SB 5) Sec. 388.003. Adoption of Building Energy Efficiency Performance Standards.

TERP adopts the energy efficiency chapter of the 2001 International Residential Code (2001 IRC) as an energy code for single-family residential construction, and the 2001 International Energy Conservation Code (2001 IECC) for all other residential, commercial and industrial construction in the state. It requires that municipalities establish procedures for administration and enforcement, and ensure that code-certified inspectors perform inspections.

TERP provides that local amendments, in non-attainment areas and affected counties, may not result in less stringent energy efficiency requirements. The Laboratory is to review local amendments, if requested, and submit an annual report of savings impacts to the TCEQ. The Laboratory is also authorized to collect fees for certain of its tasks in Sections 388.004, 388.007 and 388.008.

2.2.3 (SB 5) Sec. 388.004. Enforcement of Energy Standards Outside of Municipality

For construction outside of the local jurisdiction of a municipality, TERP provides for a building to comply if:

a) a building certified by a national, state, or local accredited energy efficiency program shall be considered in compliance;
b) a building with inspections from private code-certified inspectors using the energy efficiency chapter of the International Residential Code or International Energy Conservation Code shall be considered in compliance; and
c) a builder who does not have access to either of the above methods for a building shall certify compliance using a form provided by the Laboratory, enumerating the code-compliance features of the building.

2.2.4 (SB 5) Sec. 388.007. Distribution of Information and Technical Assistance

The Laboratory is required to make available to builders, designers, engineers, and architects code implementation materials that explain the requirements of the International Energy Conservation Code and the energy efficiency chapter of the International Residential Code. TERP authorizes the Laboratory to develop simplified materials to be designed for projects in which a design professional is not involved. It also authorizes the Laboratory to provide local jurisdictions with technical assistance concerning implementation and enforcement of the International Energy Conservation Code and the energy efficiency chapter of the International Residential Code.

2.2.5 (SB 5) Sec. 388.008. Development of Home Energy Ratings.

TERP requires the Laboratory to develop a standardized report format to be used by providers of home energy ratings (HERs). The form must be designed to give potential buyers information on a structure's energy performance, including certain equipment. TERP requires the Laboratory to establish a public information program to inform homeowners, sellers, buyers, and others regarding home energy ratings.

2.2.6 (HB 1365) Sec. 388.004. Enforcement of Energy Standards Outside of Municipality

At the 78th Legislature (2003), House Bill 1365 modified Section 388.004 of The TERP to include the following new requirements:

- That builders shall retain for three years documentation which shows their building is in compliance with the Texas Building Energy Performance Standards, and that builders shall provide a copy of the compliance documentation to homeowners.
- That single-family residences built in unincorporated areas of counties, which were completed on or after September 1, 2001, but not later than August 31, 2003, are considered in compliance with the Texas Building Energy Performance Standards.

To help builders comply with these requirements, the Laboratory will enhance the current form, which is posted on the Laboratory's The TERP website.

2.2.7 (HB 1365) Sec. 388.009. Energy-Efficient Building Program

In 2003, House Bill 1365 modified the TERP, adding a new Section 388.009. In this section the General Land Office, the TCEQ and the Laboratory, working with an advisory committee, may develop an energy-efficient building accreditation program for buildings that exceed the building energy performance standards under Section 388.003 by 15% or more. This program shall be updated annually to include best available energy-efficient building practices. This program shall use a checklist system to produce an energy-efficient building scorecard to help: (1) home buyers compare potential homes and, by providing a copy of the completed scorecard to a mortgage lender, qualify for energy-efficient mortgages under the National Housing Act; and (2) communities qualify for emissions reduction credits by adopting codes that meet or exceed the energy-efficient building or energy performance standards established under this chapter. This effort may include a public information program to inform homeowners, sellers, buyers, and others regarding energy-efficient building ratings. The Laboratory shall establish a system to measure the reduction in energy and emissions produced under the energy-efficient building program and report those savings to the commission.

2.2.8 (HB 3235) Sec. 388.009. Certification of Municipal Inspectors

Also in 2003, House Bill 3235 modified the TERP to add the new Section 388.009. In this section the Laboratory is required to develop and administer a state-wide training program for municipal building inspectors who seek to become code-certified inspectors. To accomplish this, the Laboratory will work with national code organizations to assist participants in the certification program and is allowed to collect a reasonable fee from participants in the program to pay for the costs of administering the program. This program is required to be developed no later than January 1, 2004, with state-wide training sessions starting no later than March 1, 2004.

2.2.9 (SB 20, HB 2481, HB 2129). Additional Energy-Efficiency Initiatives

The 79th Legislature (2005), through SB 20, HB 2481 and HB 2129, amended SB 5 to enhance its effectiveness by adding the following additional energy-efficiency initiatives, including requiring 5,880 MW of generating capacity from renewable energy technologies by 2015, and 500 MW from non-wind renewables.

This legislation also requires PUCT to establish a target of 10,000 MW of installed renewable capacity by 2025, and requires TCEQ to develop a methodology for computing emissions reductions from renewable energy initiatives and the associated credits. The Laboratory is to assist TCEQ in quantifying emissions reductions credits from energy-efficiency and renewable-energy programs, through a contract with the Texas Environmental Research Consortium (TERC) to develop and annually calculate creditable emissions reductions from wind and other renewable energy resources for the state's SIP.

Finally, this legislation requires the Laboratory to develop at least 3 alternative methods for achieving a 15% greater potential energy savings in residential, commercial and industrial construction. To accomplish this, the Laboratory will be using the code-compliance calculator to ascertain which measures are best suited for reducing energy use without requiring substantial investments.

2.2.10 (SB 12, HB 3693). Additional Energy-Efficiency Initiatives

The 80th Legislature (2007), through SB 12, and HB 3693 amended SB 5 to enhance its effectiveness by adding several new energy efficiency initiatives. First, it requires the Laboratory to provide written recommendations to the State Energy Conservation Office (SECO) about whether or not the energy efficiency provisions of latest published edition of the International Residential Code (IRC), or the International Energy Conservation Code (IECC), are equivalent to or better than the energy efficiency and air quality achievable under the editions adopted under the 2001 IRC/IECC. The laboratory shall make its recommendations not later than six months after publication of new editions at the end of each three-year code development cycle of the International Residential Code and the International Energy Conservation Code. As part of this work with SECO, the Laboratory is required to consider comments made by persons who have an interest in the adoption of the energy codes in the recommendations made to SECO.

In addition, it requires the Laboratory to develop a standardized report format to be used by providers of home energy ratings, including different report formats for rating newly constructed residences from those for existing residences. The form must be designed to give potential buyers information on a structure's energy performance, including: insulation; types of windows; heating and cooling equipment; water heating equipment; additional energy conserving features, if any; results of performance measurements of building tightness and forced air distribution; and an overall rating of probable energy efficiency relative to the minimum requirements of the International Energy Conservation Code or the energy efficiency chapter of the International Residential Code, as appropriate.

It also encourages the Laboratory to cooperate with an industry organization or trade association to: develop guidelines for home energy ratings; provide training for individuals performing home energy ratings and providers of home energy ratings; and provide a registry of completed ratings for newly constructed residences and residential improvement projects for the purpose of computing the energy savings and emissions reductions benefits of the home energy ratings program. Finally, it requires the Laboratory shall include information on the benefits attained from this program in an annual report to the commission.

2.2.11 (HB 1796). TERP Term & Additional Energy- Efficiency Initiatives

The 81st Legislature (2009), through HB 1796, amended sections Sec. 386.252 (a) and (b), to extend the date of the TERP to 2019 and require the TCEQ to contract with Laboratory to compute emissions reduction from wind and other renewable energy resources for the SIP.

2.2.12 (HB 51, SB 898, SB 924). Additional Energy-Efficiency Initiatives & Refinement of Ongoing Initiatives

The 82nd Legislature (2011) through HB-1, had an overall appropriation/budget reduction for TERP by 50%, (to take into effect in FY 2012). The Laboratory's funding under TERP were cut by 50% accordingly, while the Laboratory's responsibilities under TERP increased:

The 82nd Legislature (2011), through SB 898, amended Sec 388.005 (c), (d) and (e), which per the amendment, requires each political subdivision, institution of higher education or state agency to establish a goal to reduce the electric consumption by the entity by at least 5% each fiscal year for 10 years, beginning September 1, 2011. SB 898 further elaborated and enhanced the annual reporting requirements for those entities, and required SECO to develop a standardized form for reporting. SB 898 adds the Laboratory as the entity in charge of calculating energy savings and estimated emissions reduction for each political subdivision, institution of higher education or state agency, based on the information collected by SECO. The Laboratory shall share the analysis with the TCEQ, EPA and ERCOT.

The 82nd Legislature (2011), through SB 924, amended Sec 39.9051, Utilities Code, (f), (g) and (h), to enhance the reporting requirements by all municipally owned utilities and electric cooperatives that had retail sales of more than 500,000 MWh in 2005, regarding combined effects of their energy efficiency activities. Per the amended sections, beginning April 1, 2012, these entities must report each year to SECO, on a standardized form developed by SECO. The report of information regarding the combined effects of the energy efficiency activities of the electric cooperative/utility from the previous calendar year should include the annual goals, programs enacted to achieve those goals, and any achieved energy demand or savings goals. SB 924 adds the Laboratory as the entity in charge of calculating energy savings and estimated emissions reduction for municipally owned utilities and for electric cooperatives, based on the information collected by SECO. The Laboratory shall share the analysis with the PUCT, ERCOT, EPA and TCEQ.

The 82nd Legislature, through HB 51, required SECO to appoint a new advisory committee for selecting high-performance building design evaluation systems. The committee includes a representative from the Laboratory and meets at least once every two years.

The 82nd Legislature, through HB 51, modified Sec 388.003 (e) on the Laboratory's review of proposed local code amendments, which should be compared to the unamended code (instead of the "base" code), and added to Sec 388.007 (c) the fact that Laboratory is allowed to provide technical assistance concerning the implementation of local code amendments.

In addition, HB 51 added Sec 388.007 (d), which allows The Laboratory to conduct outreach to the real estate industry on the value of energy code compliance and above code construction.

3. Progress: January 2012 through December 2012

3.1 (SB 5) Section 386.205. Evaluation of State Energy-Efficiency Programs (w/PUCT)

3.1.1 Implemented Procedures for Evaluating State Energy-Efficiency Programs

In 2004 the Laboratory held several meetings with the Public Utility Commission of Texas to discuss the development of a framework for reporting emissions reduction from the State Energy Efficiency Programs administered by the PUCT. The State Energy-Efficiency Programs administered by the PUCT include programs under Senate Bill 7 (i.e., Section 39.905 Utilities Code) and Senate Bill 5.

In 2003 and 2004, the Laboratory worked with the TCEQ to identify a method to help the PUCT more accurately report their deemed savings as peak-day savings in 1999, using the Laboratory's new emissions reductions calculator. In 2005, this method was implemented in the TCEQ's Integrated Emissions Calculations, which was reported in the 2005, 2006, 2007, 2008, 2009 and 2010 annual report.

3.2 (SB 5) Sec. 388.003. Adoption of Building Energy-Efficiency Performance Standards

3.2.1 Provide Code Training Sessions

During the 77th Legislature, Senate Bill 5 (SB 5) adopted the 2000 International Residential Code (IRC) as the energy code for single-family residential construction and the 2000 edition of the International Energy Conservation Code (IECC), with the 2001 Supplement for all other residential, commercial and industrial construction in the state. It requires that municipalities establish procedures for administration and enforcement, and ensure that code-certified inspectors perform inspections.

These codes are published by the International Code Council (ICC), which publishes a new edition every three years and a supplement in the intervening years. The 2003 Codes have been reviewed and determined to be no less stringent than the editions currently adopted by SB 5. Transition to the 2003 IRC and IECC can be easily accomplished. The 2006 Codes were reviewed and the residential provisions were determined to be less stringent than the editions adopted by SB 5 while the commercial provisions were determined to be as stringent as those in SB 5. Energy System Laboratory has assisted the local legislative bodies with amendments to the residential portions of the 2006 International Energy Conservation Code to insure it remains in compliance with the State Regulations concerning stringency.

Section 388.009 requires the Laboratory to develop and administer a state-wide training program for municipal building inspectors who seek to become code-certified inspectors. To accomplish this, the Laboratory developed the Energy Code Workshops which are based on the 2003 and 2006 International Energy Conservation Code (IECC) as published by the International Code Council (ICC) for residential and commercial buildings, with amendments. In addition, three more workshops were developed that offered software training, ASHRAE Standard 62.1 and ASHRAE Standard 90.1.

The Residential Energy Code Training Workshop and Commercial Requirements of the International Energy Conservation Workshop both include an overview of the TERP program and extensive instruction on all chapters of the IECC, which include the general requirements, definitions, and design conditions. The 2003 and 2006 Residential Workshops also includes detailed instruction on Chapter(s) which contain specific regulations relating to residential construction, in addition to a comparison of the IECC and the energy provisions of the International Residential Code (IRC). The 2003 and 2006 Commercial Workshops includes detailed instruction on Chapter(s), which relate to commercial regulations and a summary of the relationship between ASHRAE 90.1 and the commercial provisions of the IECC.

In 2011, the TERP group prepared new/revised materials for the following trainings:

- The 2009 IECC training materials created for the TWC workshops in 2010/2011, were updated and consolidated into two full length workshops, one for Residential and one for Commercial.
- ASHRAE Standard 90.0-2010 full-day workshops training materials, including PPT presentation and hard copy handouts
- The materials that were developed for the ASHRAE Standard 90.0-2010 full-day workshops (seven workshops delivered in 2011 and two in 2012) were also adapted for a series of five 45-minute online sessions that were filmed during the first quarter of 2012.

3.2.2 Summary of ASHRAE Standard 90.1 Standards Committee Activities during 2012, and Ongoing Subcommittee Actions

The following paragraphs track the changes and discussion in the ASHRAE 90.1 Standard at the ASHRAE winter conference in and ASHRAE summer conference in. Both the conferences took place in 2012.

1.1.1.1 SSPC 90.1 at the ASHRAE Winter Conference in Chicago, Illinois, January 21-23, 2012

THE NEW 2013 VERSION of ASHRAE 90.1:

A new energy savings target was set for the 1013 version of ASHRAE Standard 90.1. The goal is that this new release of 90.1-2013 will have 50% energy savings compared to the 2004 version. A Progress Indicator Report was made by Bing Liu (of Pacific Northwest National Laboratory) that shows energy savings impacts of the new standard on 16 different building types analyzed in 17 different climate zones. Generally, the report indicates that the savings goal of 50% may be hard to reach. The analyses so far show a national-weighted average savings of 33.8%. Further work that looked at recent Addenda shows that once applied, the savings could reach around 53.2% after changes in Envelope, Lighting and Mechanical updates are applied.

ADVANCED ENERGY STANDARD WORKING GROUP (WG):

There is an advanced working group, chaired by Drake Erbe, that is undertaking various tasks to see what innovative ideas could be applied to various building components that could result in further energy savings. Committee members were asked to sign up for numerous work tasks and report at future meetings.

SUBCOMMITTEE REPORTS:

ENVELOPE ISSUES:

a) Report by Michael Waite. The subcommittee proposed envelope conditions for a modified App C, ECB and App G simulations – in lieu of using EnergyPlus or DOE-2. This would mean revisions to both Appendix C (Envelope trade-off) & ECB analyses. Occupancy schedules would reference the ventilation standard 62.1-2010. This new analysis procedure would be a simplified Trade-off program similar to COMcheck.
   i) Baseline buildings would use the required UF & SHGC and VT=1.1*SHGC.
   ii) Perimeter zone would have at least 50% of the LPD controlled by daylighting dimmers. Perimeter zone area would be calculated as the minimum of the whole floor area or 1.25* wall area.
b) There were a number of comments from unresolved commenters and objectors: Envelope topic -- Increase in roof insulation in metal buildings (from R-20 to R-30), commenter claims that this increases cost by $1.30/sq.ft. Problem presented about purlins being shallower than the insulation depth required to meet the new R-values. Third commenter requested that the committee consider performance based criteria for the standard (i.e., a Building Energy Performance Standard.) Fourth commenter presented a detailed discussion on cost analyses on investment vs. benefit impacts – perceived problems w.r.t. rental viability. Fifth commenter (from TC-4.4) challenged the basis of the wall insulation cost data, asserting that it is out of date as much as 13 years and that costs are underestimated and savings are overestimated. [Note: Committee is undertaking an update to the LCC cost data bases to derive new economic scalars.]
c) There was a vote taken to revise Appendix C, which includes changes to building envelope material values and schedules for occupancy and internal loads. This vote passed and will show up later as an Addendum to be voted on in the public review process. Passing of this will impact parts of section 5.6.1 and App C1, C3.

d) Another proposal from the ENV subcommittee involved some changes in the definitions section relating to roof-top monitors, clerestory, etc. when defining daylight areas. Will be out as an addendum for a public review.

ECB ISSUES:

Discussions related to VAV fan power, Chapter 11, Table 11.3.2A – Footnote d. Committee proposed a change on allowing constant volume modeling for exception (b) in Section 6.5.2.1. Discussion ensued and the motion was finally withdrawn.

The committee also considered a proposal to allow credit for reduced infiltration in Chapter 11 & Appendix G. No final vote was taken on this.

Chairperson, Jason Glazer, revealed some of the recent updates of the active working Groups in the ECB SC and their cognizant leaders:

- Active addenda to 11 or G
  - CI - Cooling towers (March 25 - May 9) No comments
  - C - Lab exhaust fan (May 6 - June 5) No comments
  - E - Existing building envelope (Mar 25 - May 9) No comments
  - CG - Lighting (May 6 - June 20) No comments
  - CJ - Datacenters (June 10 - July 25) No comments
  - D - Orientation (Mar 25 - Apr 24) 1 comment - Rosenberg (draft). The comment responses still need to be posted or confirmed by Glazer and approved by Skalko.
  - W - Renewables (June 10 - July 25) 3 comments – Brundage. The comment response still need to be posted or confirmed by Glazer and approved by Skalko.
  - Ready for first public review: AI - Related to O, M, CY; AG - Air leakage; AH – Dehumidification. The public review for these has been delayed due to a delay in the balloting of SSPC members not present at the October meetings.
  - Ready for second public review: F - Percent glazing baseline (PRD1 - Mar/Apr 2011) – Rosenberg; R - Schedule conflict and non-standard HVAC (PRD1 June/July 2011) – Taber
- Actions before full committee
  - ECB01 - McEwin Request for Interpretation - Douglas (draft). Presented to SSPC. The SSPC approved by voice vote.
  - ECB02 - VAV fan part load performance (Table 11.3.2A footnote > d), never got updated when chapter 6 reduced the threshold > for VFDs from 25 hp to 10 hp - Rosenberg (draft). During discussion at the SSPC, ECB02 was withdrawn so that it better coordinates with MSC08. It was incorporated into MSC08 by voice vote at the SSPC. The combined MSC08/ECB07 passed the SSPC 37-0-0-CNV subject to continuation ballot. This will be Addenda AQ.
- Leslie Baseline Building Heating Selection CMP (Rosenberg, Brundage, Beilman, Leslie, Foster (draft))
  - Discussion of latest draft and issue of using propane as a fuel source. The issue of the definition of "fuel" is more complex and may be addressed separately by Brundage.
  - Do we need a definition of "building area type." Motion to recommend public review and publication by Rosenberg/Brundage passed 7-0-0. Don and Neil to make presentation to SSPC. The SSPC passed the motion 31-1-5 which passes subject to continuation ballot. This will be Addenda AL.
  - Brundage drafted a response to the CMP. "Motion by Brundage/Rosenberg passed 5-0-0. The SSPC approved the response by voice vote.
- Prescriptive Plus CMP (Rosenberg, Taber, Hintz, Glazer, Eley (draft))
  - Rosenberg provided new draft. The next EA TAG meeting will not be until after these meetings and Rosenberg will try to solicit feedback. Several important members of the EA TAG support the change. Suggestions that we should we break out the individual portions so they get through public review: modeler certification, compliance path, alternative metric, using 2004 as baseline.
  - Motion to "support in principal the concept of using 2004 as a fixed baseline for Appendix G" made by Glazer/Tillou. Passed 7-0-0.
  - Motion to "support in principal the concept of using a modified Appendix G as an alternative compliance path" made by Glazer/Tillou. Passed 7-0-0.
  - This was discussed further and issues were raised by McGuir about how suitable it would be to 189.1. We need to meet with 189.1 working group.
- Walsh CMP (Talbert (draft))
  - Talbert had conference call on Jan 11 with McBride and Erbe. Mechanical is taking the lead. The document reviewed. Motion to approve this portion of the response to Walsh made by Brundage/Talbert. The vote passed 5-0-0. It will be incorporated with responses

from other subcommittees. The combined response from envelope, ecb and mechanical passed by voice vote.

- Supply-to-space temperature difference when zones are at different setpoints (Hintz (draft))
  - The proposal from August was reviewed. A question was raised if it should just be in the user's manual.
- Response to Moore CMP 0001/002 on infiltration (Tillou)
  - Reviewed the draft. Motion to recommend response of reject. Tillou/Hintz. Motion passed 7-0-0. SSPC approved response by voice vote.
- Packaged System Fan Power and removing power from EER for simulation (Tillou, Maor, Rosenberg, Douglas, Beilman (draft))
  - Reviewed latest draft from Beilman. Motion to recommend this for public review and publication by Brundate/Tillou. Motion passed 6-0-0. Concerns were raised by a subcommittee member prior to presenting to the full committee so it was not brought forward for a vote at the SSPC.
- Window Switches (Hintz, Stein)
  - Penalty for operable windows without switches and a credit for operable windows with switches. The switches reduce the conditioned air flow to the space. Question if bulk airflow model is needed to evaluate properly. Working group formed with Hintz, Taber, Beilman, Talbert, Stein with Hintz as leader.
- Review Addenda from 2007-2010 cycle to see if G or 11 need changes
  - Addenda h Dual Min Zone Controls (Maor)
  - Addenda n Single zone VAV (Talbert, Glazer (draft))
  - Addenda af/cc Pipe sizing (Rosenberg (draft))
  - Addenda as Lab Exhaust (Brundage, Maor)
  - Addenda bn Fenstration orientation (Glazer)
  - Addenda bs Receptacle (Taber (draft))
  - Addenda bx VAV Htg Temps (Maor)
  - Addenda ct Daylighting threshold (Tillou)
  - The following are waiting on a responds from Lighting (Tillou, White, Lane): Addenda al skylights in large enclosed spaces; and Addenda dd Toplighting.
  - The following are part of dehumdification addenda: Addenda b vivariums; and Addenda c Vivariums.
  - The following is part of the data center addenda CJ: Addenda bu Data centers

MECHANICAL ISSUES:

Chairperson, Martha VanGeem, revealed some of the recent updates of the active working Groups in the MSC and their cognizant leaders:

- Duct Insulation WG – Harry Misuriello
- Data Center WG (Ned Heminger)
  - Data Center WG has been meeting and reviewing CMP's as requested by MSC. Plan to have reviews complete as well as an internally generated proposal developed.
- Terminal Box Leakage WG (Jeff Boldt)
  - Responses to comments voted on by SSPC for Addendum x. Resulting in an ISC.
- Controls WG (Tim Peglow)
  - Addendum aa – further discussions to take place with commenter.
- Elevators WG (Jeff Boldt)
  - This was to come to the MSC in April.
- Thermal Storage WG – Steve Rosenstock
- Hydronics WG (Jeff Boldt)
  - No activity at this time.
- Laboratory WG (Ned Heminger)
  - No activity at this time.
- Healthcare WG (Jeff Boldt)
  - Discussed possible proposal on leakage requirements for rooms required to maintain pressure relationships with adjacent spaces. Will be taken up at the subcommittee's

spring interim meeting.

- Chiller Plant WG (Frank Morrison/Susanna Hanson)
  - Reported as part of MSC proposal HVAC-15.
- Heat Recovery WG (Susanna Hanson)
  - Reported as part of MSC proposal HVAC-17.
- Filter WG (Tim Peglow)
- Economizer WG (Dick Lord - Susanna)
- Radiant Heating/Cooling WG (Richard Watson)
  - Motion MSC 19 (addendum "ap") to submit a Continuous Maintenance Proposal (CMP) for publication and public review. Proposal is to add a new alternative compliance path for data centers (proposed by TC-9.9.) Refers to new limits on the PUE (power usage effectiveness) numbers. PUE = Total load to IT load ratio. Impacts Section 6.6.1 Computer Room Systems. New table showing different PUE limits in each climate zone.

  - Motion MSC 22: Proposed addendum "at" to reduce the economizer requirement to 5 tons, also limits on VAV fan motor sizes (<3/4 h.p.) in Fan Power Limitations section. Also ECB CMP proposal on VAV Fan Power, Chapter 11.

  - MSC 07: Commercial refrigeration proposal. Intent is to meet new federal standards on walk-in coolers and freezers, to update a number of definitions of same, set requirements for condenser motor efficiencies, and to include requirements for closures. Discussion included comments about addressing the "R" in ASHRAE, and under the topic of HVAC&R that refrigeration and air conditioning are increasingly becoming converging technologies. So, refrigeration might need to be addressed with more stringency in the energy standards. Motion was passed to accept Addendum "ar" CMP for publication and public review.

  - Motion 25. Section 6.5.2.4. Proposal on insulation of heat exchanger tubes, humidifier, preheating jackets, etc. Recommendation is for an R-value of at least 0.5. Vote passed for publication and public review.

  - Motion CC-01. Combo committee CMP proposal from MSC/ENV/LTG. Response to a CMP submitted from outside, to reject comment alleging the need to clarify the reference to the proper weather data to use.

LIGHTING ISSUES:

Lighting Motion 18 (addendum "ao") was proposed to submit a CMP (for publication and public review) that would replace the whole-building method (which is now section 9.5), by creating Section 9.3 called "Simplified method for whole buildings", utilizing information from the AEDG booklets. This would add Table 9.3.1, "Whole Building Method Lighting Criteria" with new LPDs and control requirements for each of the building types. It would also include exterior lighting LPDs and controls. Motion was passed by the full committee.

1.1.1.2 SSPC 90.1 at the ASHRAE Summmer Conference in San Antonio, Texas, June 23-25, 2012

ECB ISSUES:

Chairperson, Jason Glazer, revealed some of the recent updates of the active working Groups in the ECB SC and their cognizant leaders:

- Baseline to 2004 proposal (Rosenberg)
  - Editorial changes made during meeting. Motion for publication and public review by Rosenberg seconded by Brundage passed 8-0-0. Note: The SSPC approved this for publication and public review by the vote 26-1-4. It will be Addendum BM.

- Packaged System Fan Power and removing power from EER for simulation (Tillou, Maor, Rosenberg, Douglas, Beilman (draft))
  - On Friday evening, Beilman reviewed proposal with subcommittee. Revised language during discussion. Motion for publication and public review made by Tillou and seconded by Douglas. Motion passed 7-0-0. Issues uncovered prior to presentation to SSPC on Saturday. During Saturday ECB meeting revised language further. Motion for publication and public review made by Rosenberg and seconded by Brundage. Motion passed 8-0-0. Note: The SSPC passed Motion 19 by the vote 23-2-5 subject to continuation ballot. This will be Addendum BL.
- COMNET sections in Appendix G - plug loads, refrigeration, tolerances around 140 tests, outdoor lighting schedules, TOU energy costs, equipment curves (Douglas, Rosenberg, Cherniack, Contoyannis)
  - Contoyannis spoke about COMNET and announced that the 2010 version will be out soon and the interest in parts of it becoming an ANSI standard. COMNET was funded by the Energy Foundation through New Buildings Institute. They are still determining if they want to submit CMPs to 90.1 or if they should be independent standards.
- Section 6.5.3.1 and Section 11.3.2.h (Douglas)
  - No change needed. Existing language was worded to not allow gaming on belt losses. Douglas will discuss with original person that noticed the difference.
- Table G3.1-5b Edits from Hogan (Beilman (draft))
  - Beilman will review Addendum E and see if it changes the proposed edits.
- Window Switches (Hintz, Stein)
  - Tillou volunteered to do some analysis on this topic. Tillou was added to working group.
- Parallel Fan Powered Boxes (Hintz (new report))
  - Faris made unscheduled presentation related to proposals he had submitted Friday morning. Hintz and Beilman will work on this. Need to coordinate with mechanical subcommittee on this change.
- Kitchen Hoods (Beilman)
  - Beilman will review language submitted by Stein related to Title 24 revision.
- Review Addenda from 2007-2010 cycle to see if G or 11need changes
  - Addenda h Dual Min Zone Controls (Maor)
  - Addenda n Single zone VAV (Talbert, Glazer (draft))
  - Addenda af/cc Pipe sizing (Rosenberg (draft))
  - Addenda as Lab Exhaust (Brundage, Maor)
  - Addenda bn Fenstration orientation (Glazer)
  - Addenda bs Receptacle (Taber (draft))
  - Addenda bx VAV Htg Temps (Maor)
  - Addenda ct Daylighting threshold (Tillou)
  - The following are waiting on a responds from Lighting (Tillou, White, Lane): Addenda al skylights in large enclosed spaces; and Addenda dd Toplighting.
  - The following are part of dehumdification addenda: Addenda b vivariums; and Addenda c Vivariums.
  - The following is part of the data center addenda CJ: Addenda bu Data centers

3.3 Laboratory's TERP Web Site "esl.tamu.edu/terp"

Since the fall of 2001, the Laboratory has maintained a TERP webpage, where information is provided to builders, code officials, the design community and homeowners about TERP. In 2010, the Laboratory redesigned its website to make navigation easier. On the navigation bar is a tab that links to the TERP homepage (Figure 28). The homepage contains the following items:

- Definition of the Texas Emissions Reduction Plan
- Texas Work
  - TERP Objectives

    - TERP Elements
    - ESL's TERP Responsibilities
    - The CATEE Conference
    - Links to
        - Texas Legislative Testimony by the ESL
        - TERP Legislative History
- National Work
    - National Center of Excellence on Displaced Emission Reductions (CEDER)
    - Links to
        - CEDER Program
        - EPA Recognizes ESL and Dallas Partners

In addition, the TERP homepage also includes a sidebar on the left with links to the latest articles and news.

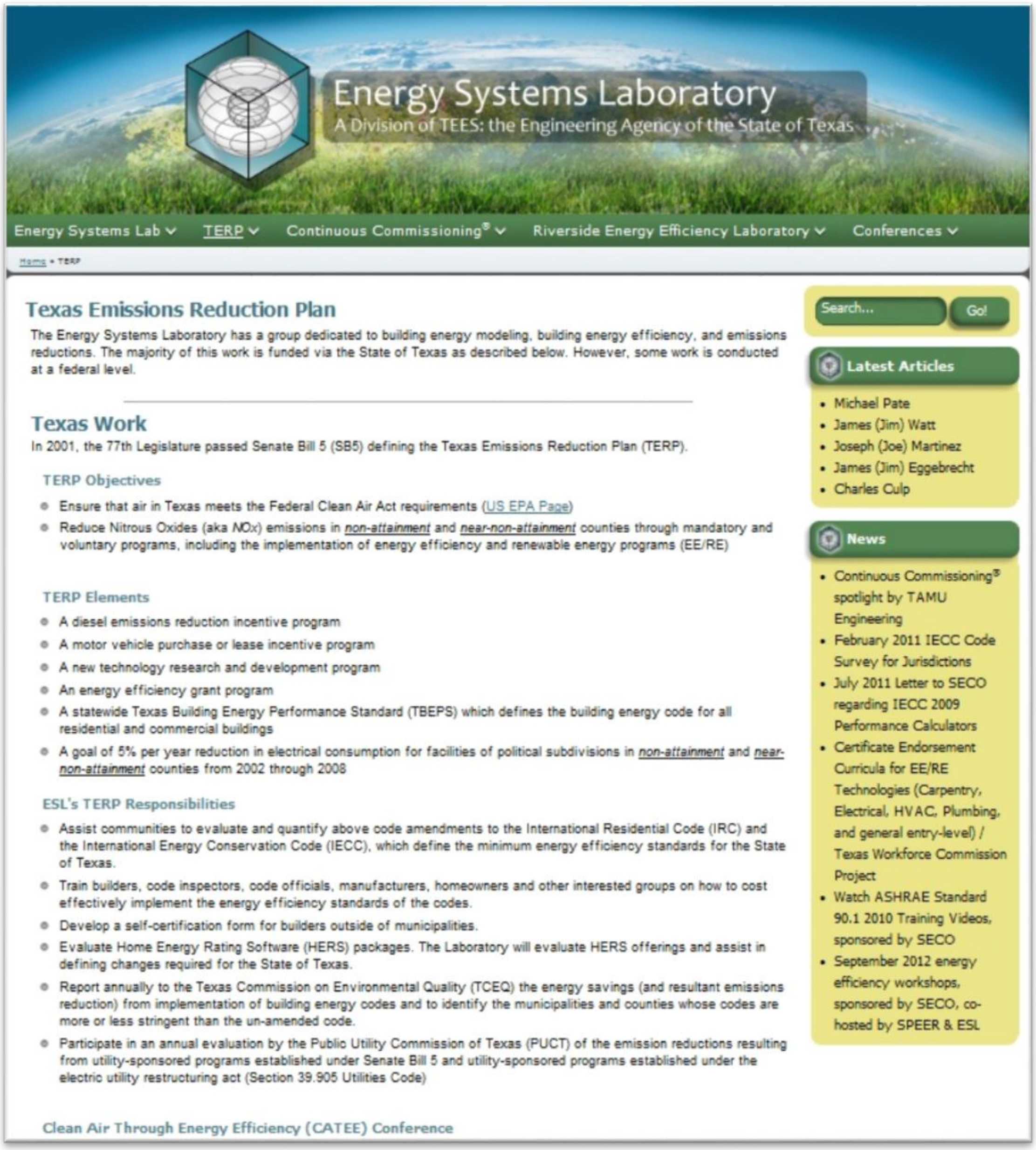


Figure 27. TERP Home Page

The TERP tab also contains a dropdown menu which provides links to the following sections

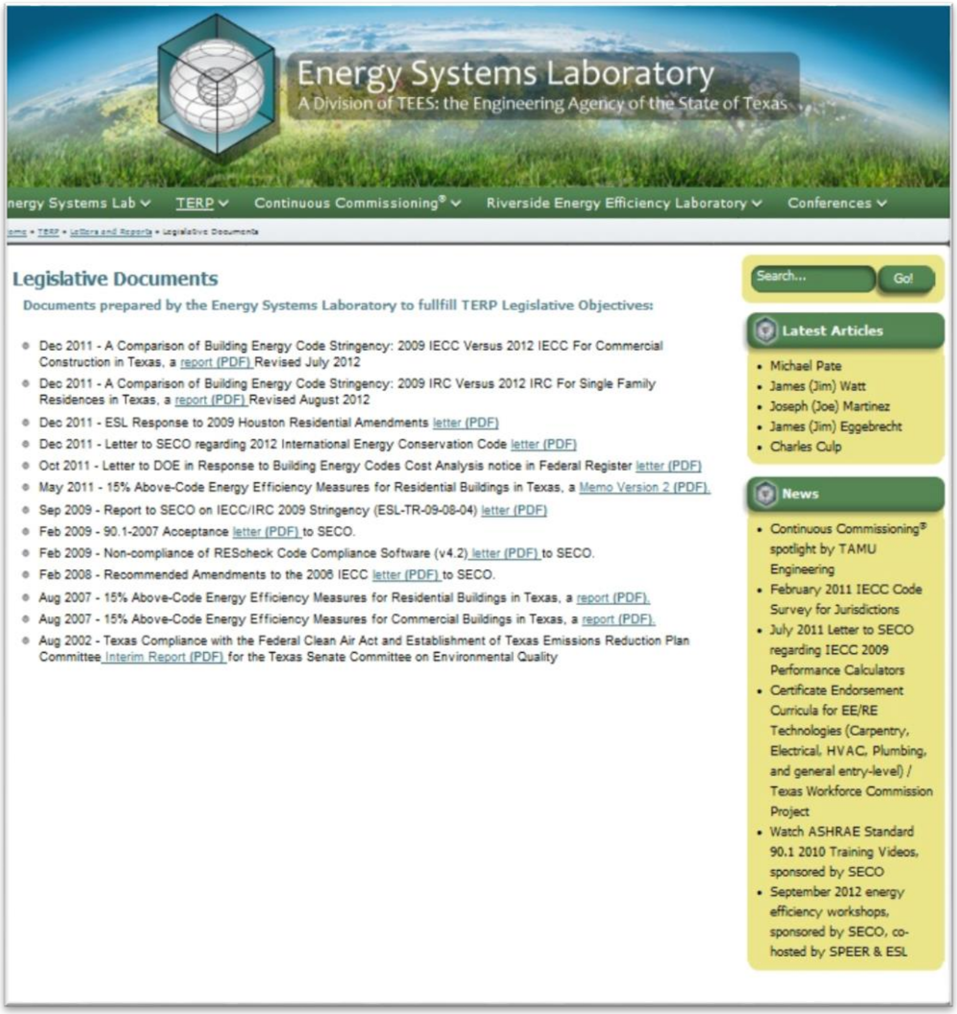


Figure 28: TERP –Letters and Reports

- Code Compliance Calculator
  - IC3
    - Help and Support – contains IC3 Help Resources including
      - Supplemental Release Notes
      - What's New in this Version?
      - Manual
      - Detailed Release Notes for current release of IC3
      - Aggregate Reports from IC3 – Location, parameters and maps.
      - Contact information
      - Workshops
      - FAQ
      - RESNET Certification Resources
        - Report

            - News – includes information about improvements and fixes to IC3 Workshops – description of IC3 Workshops, including contact information
            - FAQs
            - IC3 Reports – contains data from ESL's research and software projects
                - IC3 – Registry House Parameters (updated monthly)
                    - Envelope
                    - Systems
                    - Mixed
                - Texas Building Registry Demographics
                    - Texas
                    - Counties
                    - Cities
                    - TCV (Travis County & Austin)
                - Weather Data
    - TCV
        - Help & Support – contains TCV Help & Support and contact information
        - News – includes TCV News including
            - What's New in Version 1.1
            - What is the Difference between TCV v1.1 and IC3 v3.x?
        - FAQs
    - Other Legacy calculators
        - AIM Calculator
        - eCalc 1.x Calculator
    - Credits
- Letters and Reports
    - Legislative Documents
    - Builders Information
    - EPA/CEDER Work
        - Background
        - Reports provided to US EPA as part of CEDER Program
    - Reports – listed by year from 2002-2012
- About
    - Legislative Testimony
    - Legislative Documents
    - Legislative History
- TERP Data Sets
    - Weather Data
    - Texas Building Registry
        - IC3/TCV Usage Reports
        - IC3 House Construction Trends
- TERP Links
    - eCalc Emissions & Energy Calculator
    - International Code Compliance Calculator (ICCC)
    - Public Utility Commission of Texas (PUC)
    - U.S. Department of Energy (DOE)
    - Texas State Conservation Office (SECO)
    - U.S. Environmental Protection Agency (EPA)
    - International Code Council (ICC)
    - American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
    - North Central Texas Council of Governments (NCTCOG)

  - Alamo Area Council of Governments (AACOG)
  - Circle of Ten
  - Texas Home Energy Rating Organization (TxHERO)
- Other Publications
  - Builders Information
  - Digital Library
  - Presentations
  - Proceedings
    - Air Quality (CATEE)
    - Hot & Humid
    - IBPSA
    - ICEBO
    - IETC
- Workshops
  - IC3
  - IECC Residential
  - IECC Commercial
  - ASHRAE

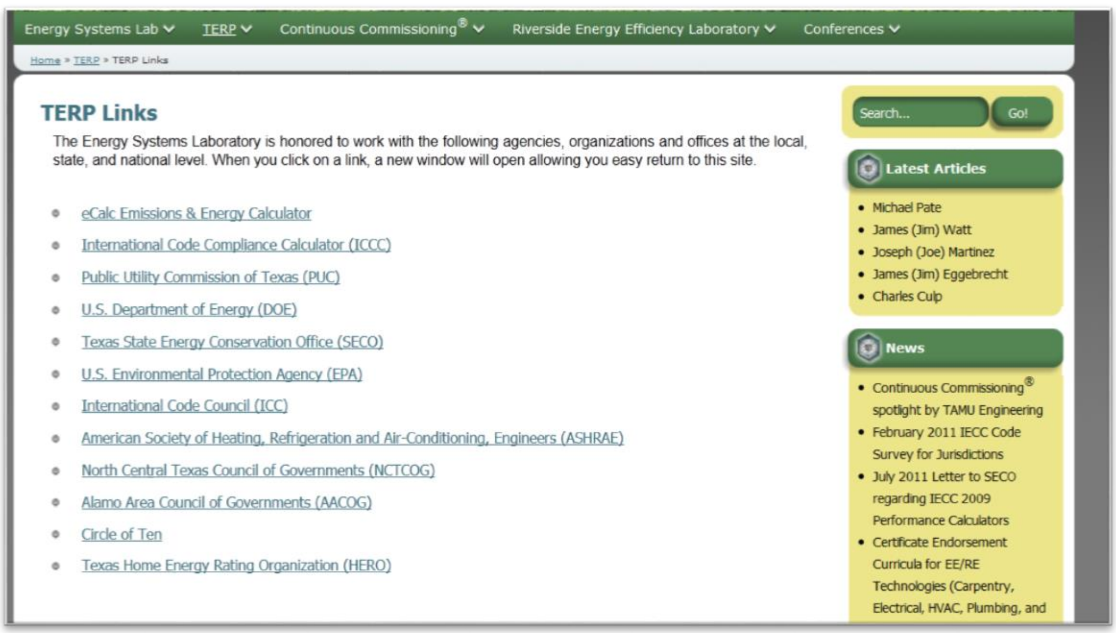


Figure 29: TERP Links

The Energy Systems lab also hosted the Clear Air Through Energy Efficiency Conference (CATEE)

CATEE 2012 Program

Tuesday, Oct. 9 – Pre-Conference Workshops	
10:00am-12:00pm	**New Funding Alternatives, Sources and Strategies To Create High-Performing, Energy Efficient Buildings (.2 CEU/2 PDH)**
1:00pm-5:00pm	**School Energy Management (.4 CEU/4 PDH)**
1:00pm-5:00pm	**Which Green Rating System is Right for You? (.4 CEU/4 PDH)**
Wednesday, Oct. 10 – Day One of Conference (.6 CEU/6PDH)	
7:30am	Registration opens
8:00am	Exhibits open

8:30am	**Opening Plenary:**
	• Welcome Remarks & Introductions
	  ◦ *The Honorable Lewis Rosen, Mayor of Galveston*
	  ◦ *Dr. David Claridge, Director, Energy Systems Laboratory*
	• Electric Resources in Texas - *Brian Lloyd, Executive Director, Public Utility Commission of Texas*
	• Efficiency & Demand Response - *Paul Wattles, Sr. Analyst, Market Design, ERCOT*
	• EPA Perspectives - *Carl Edlund, Director, Multi-media Planning & Permitting, USEPA Region 6*
	• Keynote: Sustainability Leadership - *Major General Dana J.H. Pittard, Commanding General, 1st Armored Division and Fort Bliss, TX*

Figure 30: CATEE Conference

2012 Presentations

Arneson – Tremont House and Hotel Galvez Sustainability Modifications – PDF, Slides/Audio
Bartel – Transforming the Future of Electric Distribution & Energy Consumption – PDF, Slides/Audio
Brasora – City of Dallas Green Buildings Case Study – PDF, Slides/Audio
Blake – Raising the Bar : Houston – PDF, Slides/Audio
Brown – Success in School Energy Management – PDF , Slides/Audio
Claridge – Reducing Energy Use with 50% ROI through Continuous Commissioning® – PDF, Slides/Audio
Copithorne – On-Bill Repayment: A Proposal to Increase Investment in Texas – PDF, Slides/Audio
Corbitt – Success in School Energy Management:Energy Monitoring – PDF, Slides/Audio
DuPlessis – Behavioral Modification – PDF, Slides/Audio
Edlund – Texas Air Quality and the Role of Energy Efficiency – PDF, Slides/Audio
Forrest – New Technologies That Work – PDF, Slides/Audio
Fyock – Insight into Corporate Energy Management Trends: Focus on Texas – PDF, Slides/Audio
Haberl – Emissions Reduction Impact of Renewables – PDF, Slides/Audio
Haberl – EE/RE Impacts on Emission Reductions – PDF, Slides/Audio
Hamilton – Combustion and Health – PDF, Slides/Audio
Hanel & Tyra - Oncor Energy Efficiency Programs Solar Photovoltaic - PDF, Slides/Audio
Hatcher – Application of CC at a Corporate Headquarters Facility in Dallas, TX – PDF, Slides/Audio
Herweck – New Technologies That Work – PDF, Slides/Audio
Heydinger – Energy Efficiency Financing: PACE – PDF, Slides/Audio
Hildebrand – Texas Air Quality Status and the Texas Emissions Reduction Plan – PDF, Slides/Audio
Jones – Comfort by Design – PDF, Slides/Audio
Lloyd – Texas Electricity Update – PDF
Martin – Utility Goals for the – PDF, Slides/Audio
Morrison – Smart Energy Presentation – PDF, Slides/Audio
Neukomm - Better Buildings – PDF, Slides/Audio
Pelz – The Green Revival Program – PDF, Slides/Audio
Peterson – Sustainability Engagement Strategy – PDF, Slides/Audio

Figure 30: CATEE Conference (continued)

3.3.1 Provide Technical Assistance to the TCEQ

The Laboratory received dozens of calls per week from code officials, builders, home owners and municipal officials regarding the building code and emissions calculations. A complete file of these transactions is maintained at the Laboratory.

3.4 Delivered "Statewide Air Emissions Calculations from Wind and Other Renewables: Summary Report September 2012 – July 2013," to the Texas Commission on Environmental Quality in August 2013.

The Energy Systems Laboratory, in fulfillment of its responsibilities under this Legislation, submits its annual report, "Statewide Air Emissions Calculations from Wind and Other Renewables," to the Texas Commission on Environmental Quality.

The report is organized in several deliverables:

- a summary report, which details the key areas of work
- supporting documentation
- supporting data files, including weather data, and wind production data, which have been assembled as part of the year's effort

The executive summary provides summaries of the key areas of accomplishment this year, including:

- continuation of stakeholder's meetings
- analysis of power generation from wind farms using improved method and 2011 and 2012 data
- analysis of emissions reduction from wind farms
- updates on degradation analysis
- analysis of other renewables, including PV, solar thermal, hydroelectric, geothermal and landfill gas
- review of electricity generation by renewable sources and transmission planning study reported by ERCOT

3.4.1 Analysis of wind farms using improved method and 2011 and 2012 data

In this report, the weather normalization procedures, developed together with the Stakeholders, were presented and applied to all the wind farms that reported their data to ERCOT during the 2011 and 2012 measurement period, together with wind data from the nearby NOAA weather stations. In the 2011 Wind and Renewables report to the TCEQ (Haberl et al. 2011), weather normalization analysis methods were reviewed.

This report used the same analysis method as the previous 2010 report (Sweetwater III as an example) to present the same weather normalization procedure, including:

- the processing of weather and power generation data, modeling of daily power generation versus daily wind speed using the ASHRAE Inverse Model Toolkit (IMT) for two separate periods, i.e., Ozone Season Period (OSP), from July 15 to September 15, and Non-Ozone Season Period (Non-OSP);
- predicting 2008 wind power generation as a baseline, using developed coefficients from 2011 daily OSP and Non-OSP models for all the wind farms; and
- the analysis on monthly capacity factors generated using the models

A summary of total wind power production in the base year (2008) for all of the wind farms in the ERCOT region using the developed procedure is presented, and the new wind farms which started operation in 2011 were added, including Cedro Hill Wind, Loraine Windpark III and Papalote Creek Phase II. Figure 3-31 shows the measured annual wind power generation in 2011 and the estimated wind power generation in 2008 using the developed method for those wind farms in the ERCOT region. The total measured wind power generation in 2011 is 27,536,276 MWh/yr., which is 2.7% less than what the same wind farms would have produced in 2008. Figure 3-32 shows the same comparison but for the Ozone Season Period. The measured wind power generation in the OSP of

2011 is 57,096 MWh/day, which is 14.26% higher than the 2008 OSP baseline wind production. Especially for wind farms named BUFF_GAP_UNIT2 and SWEETWN3_WND3, there are missing data period from January to June. Only six month wind power data available result in the huge difference between measured 2011 ERCOT wind power production and estimated 2008 wind power production.

This report also includes an uncertainty analysis that was performed on all the daily regression models for the entire year and Ozone Season Period. The detailed analysis for each wind farm is provided in the Appendix B to this report. The original data used in the analysis is included in the accompanying CD-ROM with this report.

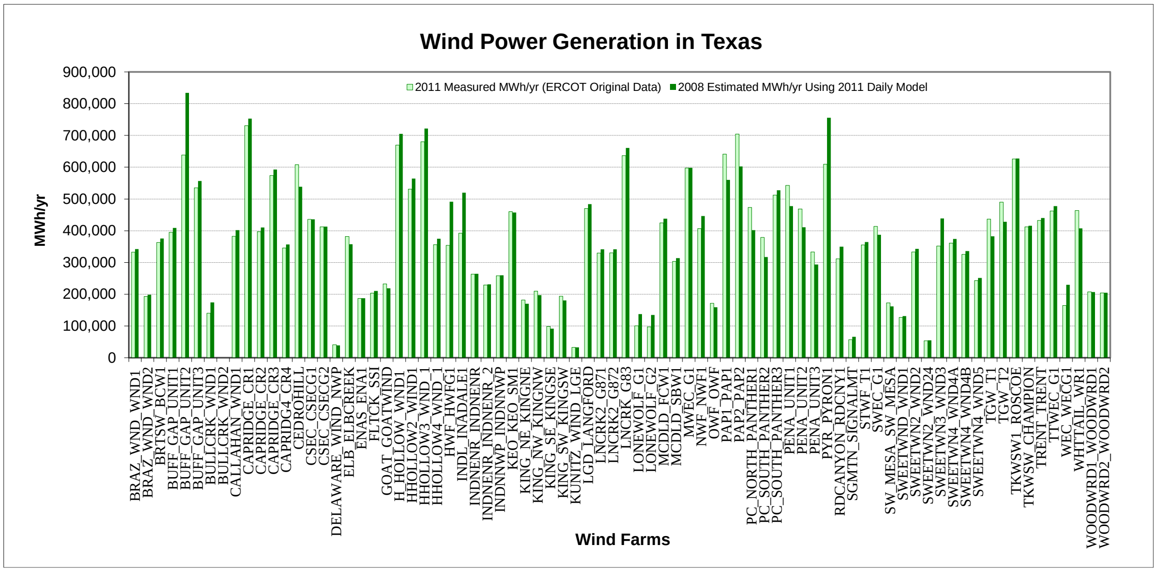


Figure 3-31: Comparison of 2011 Measured and 2008 Estimated Wind Power Production for Each Wind Farm

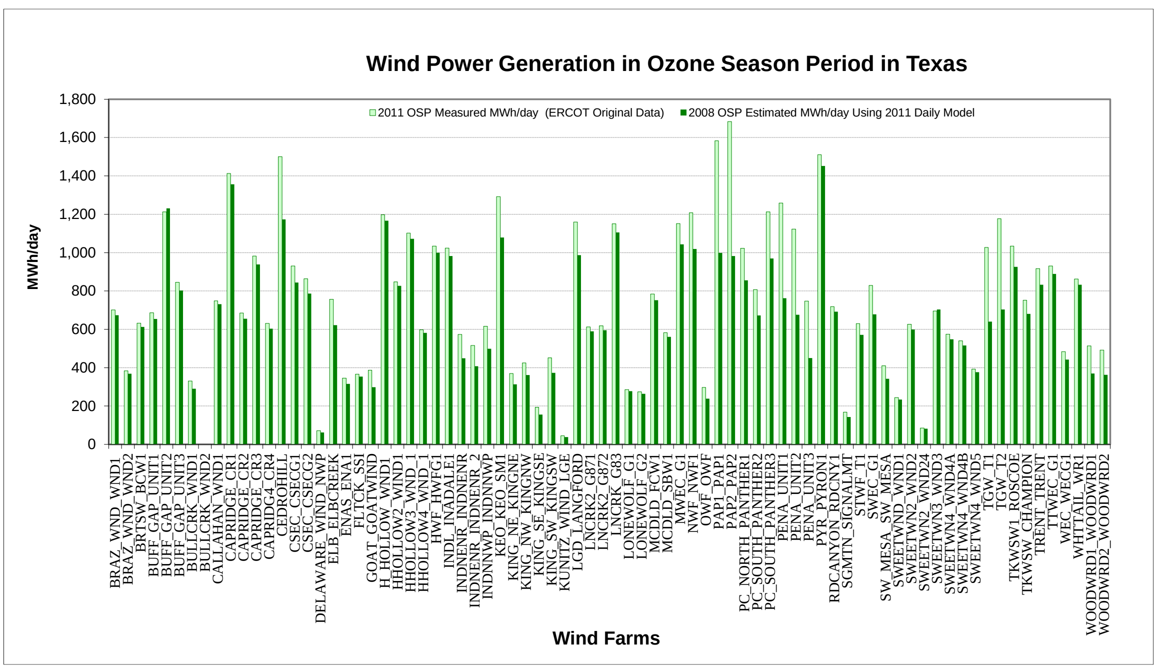


Figure 3-32: Comparison of 2011 OSP Measured and 2008 OSP Estimated Wind Power Production for Each Wind Farm

1.1.1.3 Analysis of emissions reductions from wind farms

In this report, the procedure for calculating annual and peak-day, county-wide NOx reductions from electricity savings from wind projects implemented in the congestion management (CM) zones in ERCOT was presented and, calculating the NOx emission reductions based on the special version of 2010 eGRID, developed by the ESL and EPA for the TCEQ. According to the developed models, the total MWh savings for all the wind farms in the base year 2008 within the ERCOT region are 28,299,330MWh and 49,971MWh/day in the Ozone Season Period. The total NOx emissions reductions across all the counties amount to 7,745.15 tons/yr. and 13.69 tons/day for the Ozone Season Period. Based on the 2011 measured ERCOT data, the total MWh savings for all the wind farms within the ERCOT region are 27,536,276 MWh and 57,096 MWh/day in the Ozone Season Period. The total NOx emissions reductions in 2011 across all the counties amount to 7,569.94 tons/yr. and 15.81 tons/day for the Ozone Season Period. Compared to the base year 2008, the total annual NOx emissions reductions decreased by 2.26%, and the total NOx emissions reductions increase 15.5% for the Ozone Season Period.

1.1.1.4 Development of a degradation analysis

This report contains an updated analysis to determine what amount of degradation could be observed in the measured power from Texas wind farms. Currently, the TCEQ uses a very conservative 5% degradation per year for the power output from a wind farm when making future projections from existing wind farms. Accordingly, the TCEQ asked the ESL to evaluate any observed degradation from the measured data for Texas wind farms. To accomplish this, forty three wind farms (38 sites) built from 2001 to 2011 were evaluated with a total capacity of 4,664.1 MW in this report. This year, twenty two qualified wind farms were added for the analysis because at least four- year measured data were required for the analysis.

In this analysis, a sliding statistical index was established for each site that used the 10th, 25th, 50th, 75th, 90th, and 99th percentiles of the hourly power generation over a 12-month sliding period, as well as mean, minimum and maximum hourly power generation of the same 12-month period. These indices were then displayed using one data symbol for each 12-month slide, beginning from the first 12-month period until the last 12-month period for each of the wind farms.

Of the thirty eight sites analyzed, nineteen sites showed an increase when one compares the 90th percentile of the whole period to the 90th percentile of the first 12-month period, ranging from 0.1 % to 68%. The remaining nineteen sites showed a decrease from -0.5% to -32.6%. The weighted average of this increase across all wind farms studied is 5% (positive), which indicates that no degradation was observed from the aggregate energy production from these wind farms over the studied operation period. Based on the observations, special attentions need to be paid to site Buffalo Gap 1 (-17.9%), Big Spring Wind Power (-11.7%), Capricorn Ridge Wind (-10.4%), Snyder Wind Project (-17.1%), Texas Wind Power Project (-32.6%) and Whirlwind (-14.7). Those wind farms have comparison percentage larger than 10%, which may be caused by wind farm operations issues, the meter problems or other issues that have not been aware of.

1.1.1.5 Analysis of other renewable sources

Other renewable energy projects throughout the state of Texas were located to determine NOx emissions reduction and are included in this section. Searches were conducted on five specific categories which include solar photovoltaic, solar thermal, geothermal, hydroelectric, and Landfill Gas-Fired Power Plants. Many newly located renewable energy projects are assembled for inclusion in this report. NOx emissions reduction were calculated for only the solar photovoltaic and solar thermal projects.

County-wide NOx reductions from electricity savings from solar photovoltaic and solar thermal projects based on the special version of Texas 2010 eGRID. According to the developed models, the total energy savings for all the solar photovoltaic within the ERCOT region for the year 2012 were 176,311 MWh and 527 MWh/day in the Ozone Season Period. The total annual NOx emissions reductions across all the counties amount to 59.42 tons/yr and 0.178 tons/day for the Ozone Season Period. Similarly, the total MWh savings for all the solar thermal projects for year 2012 were 232 MWh and 1.0 MWh/day in the Ozone Season Period and the total NOx emissions reductions across all the counties amount to 0.072 tons/yr. and 0.00019 tons/day for the Ozone Season Period.

1.1.1.6 Review of electricity savings and transmission planning study reported by ERCOT

In this report, the information posted on ERCOT’s Renewable Energy Credit Program site www.texasrenewables.com is reviewed. In particular, information posted under the “Public Reports” tab was downloaded and assembled into an appropriate format for review. This includes ERCOT’s 2001 through 2012 reports to the Legislature and information from ERCOT’s listing of REC generators.

Each year ERCOT is required to compile a list of grid-connected sources that generate electricity from renewable energy and report them to the Legislature. Table 3-1 contains the data reported by ERCOT from 2001- 2012. Figure 3-33 is included to better illustrate the annual data collected by ERCOT.

Table 3-1: Annual Electricity Generation by Renewable Resources (MWh, ERCOT: 2001 - 2012)

Technology Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Biomass	0	0	39,496	36,940	58,637	60,569	54,101	70,833	73,364	97,535	137,004	288,988
Hydro	30,639	312,093	239,684	234,791	310,302	210,077	382,882	445,428	507,507	609,257	267,113	389,197
Landfill gas	0	29,412	154,206	203,443	213,777	306,087	356,339	387,110	412,923	464,904	497,645	537,966
Solar	0	87	220	211	227	470	1,844	3,338	4,492	14,449	36,580	133,642
Wind	565,597	2,451,484	2,515,482	3,209,630	4,221,568	6,530,928	9,351,168	16,286,440	20,596,105	26,828,660	30,769,674	32,746,534
Total (MWh)	596,236	2,793,076	2,949,087	3,685,014	4,804,512	7,108,131	10,146,333	17,193,150	21,594,390	28,014,805	31,708,016	34,096,328

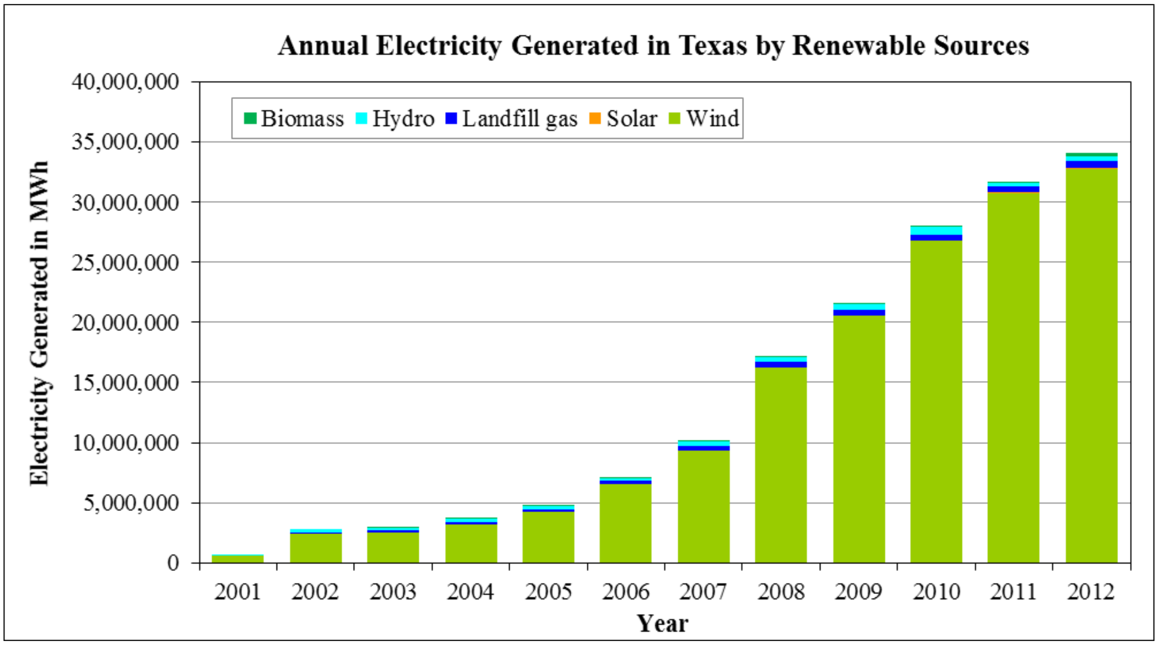


Figure 3-33: Electricity Generation by Renewable Resources (ERCOT: 2001–2012 Annual)

3.5 Technical Assistance

The Laboratory provides technical assistance to the TCEQ, the PUC, SECO and ERCOT, as well as Stakeholders participating in a number of conferences and presentations. In 2011, the Laboratory continued to work closely with the TCEQ to develop an integrated emissions calculation, which provided the TCEQ with a creditable NOx emissions reduction from energy efficiency and renewable energy (EE/RE) programs reported to the TCEQ in 2005, 2006, 2007, 2008, 2009, 2010 and 2011 by the Laboratory, PUC, SECO, and Wind-ERCOT.

The Laboratory has also enhanced the previously developed emissions calculator by: expanding the capabilities to include all counties in ERCOT, including the collection and assembly of weather from 1999 to the present from 17 NOAA weather stations, and enhancing the underlying computer platform for the calculator.

The Laboratory has and will continue to provide leading edge technical assistance to counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering the emissions and improving the air for all Texans. The Laboratory will continue to provide superior technology to the State of Texas through efforts with the TCEQ and US EPA. The efforts taken by the Laboratory have produced significant success in bringing EE/RE closer to US EPA acceptance in the SIP.

Table 1: 2000/2001 IECC Performance Path vs. 2009 IECC Performance Path

County	IECC 2009 Weather Zones	Energy Type**	Total Annual Savings of the IECC 2009 Performance Path compared to the IECC 2000/2001 (%)*	
			Gas Heating, DHW	Heat Pump Heating, Electric DHW
Houston (HAR)	2A	Site	10.9 %	10.9 %
		Source	11.9 %	10.9 %
Brownsville (CAM)	2B	Site	16.4 %	13.6 %
		Source	15.1 %	13.6 %
Dallas (TAR)	3A	Site	12.8 %	10.8 %
		Source	12.3 %	10.8 %
El Paso (ELP)	3B	Site	10.2 %	10.0 %
		Source	11.2 %	10.0 %
Amarillo (ARM)	4B	Site	16.0 %	14.6 %
		Source	16.7 %	14.6 %

**Base-case Simulation Assumptions:* Analysis used single-family house, 2,500 ft^2, single story, four bedrooms, slab-on-grade, ducts in the unconditioned, ventilated attic, window-to-floor ratio: 18% for 2000/2001, 15% for 2009, windows equally distributed (N,E,S,W), and no exterior shading. HVAC Distribution efficiency: 0.8 for 2000/2001, 0.88 for 2009. All other roof, wall and window parameters as per 2000/2001 and 2009 IECC for county shown (IC3 ver. 3.03.02).
***Source Energy Consumption*: A factor of 3.16 was used to calculate the source electricity consumption. A factor of 1.1 was used to calculate source gas energy consumption.

Table 2: 2000/2001 IECC Performance Path vs. 2009 IECC Prescriptive Path

County	IECC 2009 Weather Zones	Energy Type**	Total Annual Savings of the IECC 2009 Prescriptive Path compared to the IECC 2000/2001 (%)*	
			Gas Heating, DHW	Heat Pump Heating, Electric DHW
Houston (HAR)	2A	Site	7.8 %	8.7 %
		Source	9.1 %	8.7 %
Brownsville (CAM)	2B	Site	14.3 %	11.6 %
		Source	13.0 %	11.6 %
Dallas (TAR)	3A	Site	9.6 %	8.6 %
		Source	9.6 %	8.6 %
El Paso (ELP)	3B	Site	7.0 %	8.3 %
		Source	8.9 %	8.3 %
Amarillo (ARM)	4B	Site	10.7 %	11.9 %
		Source	13.1 %	11.9 %

**Base-case Simulation Assumptions:* Analysis used single-family house, 2,500 ft^2, single story, four bedrooms, slab-on-grade, ducts in the unconditioned, ventilated attic, window-to-floor ratio: 18% for 2000/2001, 15% for 2009, windows equally distributed (N,E,S,W), and no exterior shading. HVAC Distribution efficiency: 0.8 for 2000/2001; for 2009 IECC, HVAC distribution efficiency simulated using R8 insulation for supply, R6 for return ducts and total duct leakage of 11% to outdoor. All other roof, wall and window parameters as per 2000/2001 and 2009 IECC for county shown (IC3 ver. 3.03.02).
***Source Energy Consumption*: A factor of 3.16 was used to calculate the source electricity consumption. A factor of 1.1 was used to calculate source gas energy consumption.

Table 3: 2000/2001 IECC Performance Path vs. Chapter 11 of the 2009 IRC Prescriptive Path

County	IECC 2009 Weather Zones	Energy Type**	Total Annual Savings of the IRC 2009 compared to the IECC 2000/2001 (%)*	
			Gas Heating, DHW	Heat Pump Heating, Electric DHW
Houston (HAR)	2A	Site	7.7 %	7.7 %
		Source	8.3 %	7.7 %
Brownsville (CAM)	2B	Site	13.7 %	10.4 %
		Source	11.8 %	10.4 %
Dallas (TAR)	3A	Site	9.9 %	7.8 %
		Source	9.0 %	7.8 %
El Paso (ELP)	3B	Site	7.1 %	7.1 %
		Source	7.9 %	7.1 %
Amarillo (ARM)	4B	Site	10.7 %	11.9 %
		Source	13.1 %	11.9 %

**Base-case Simulation Assumptions:* Analysis used single-family house, 2,500 ft^2, single story, four bedrooms, slab-on-grade, ducts in the unconditioned, ventilated attic, window-to-floor ratio: 18% for 2000/2001, 15% for 2009 IRC, windows equally distributed (N,E,S,W), and no exterior shading. HVAC Distribution efficiency: 0.8 for 2000/2001; for 2009 IRC, HVAC distribution efficiency simulated using R8 insulation for supply, R6 for return ducts and total duct leakage of 11% to outdoor. All other roof, wall and window parameters as per 2000/2001 and 2009 IRC for county shown (IC3 ver. 3.03.02).

***Source Energy Consumption*: A factor of 3.16 was used to calculate the source electricity consumption. A factor of 1.1 was used to calculate source gas energy consumption.

3.6 Presentations to various entities and conferences.

The Energy Systems Laboratory made presentations at several conferences about ways to save energy.

Presentation to the City of Arlington, February 2012

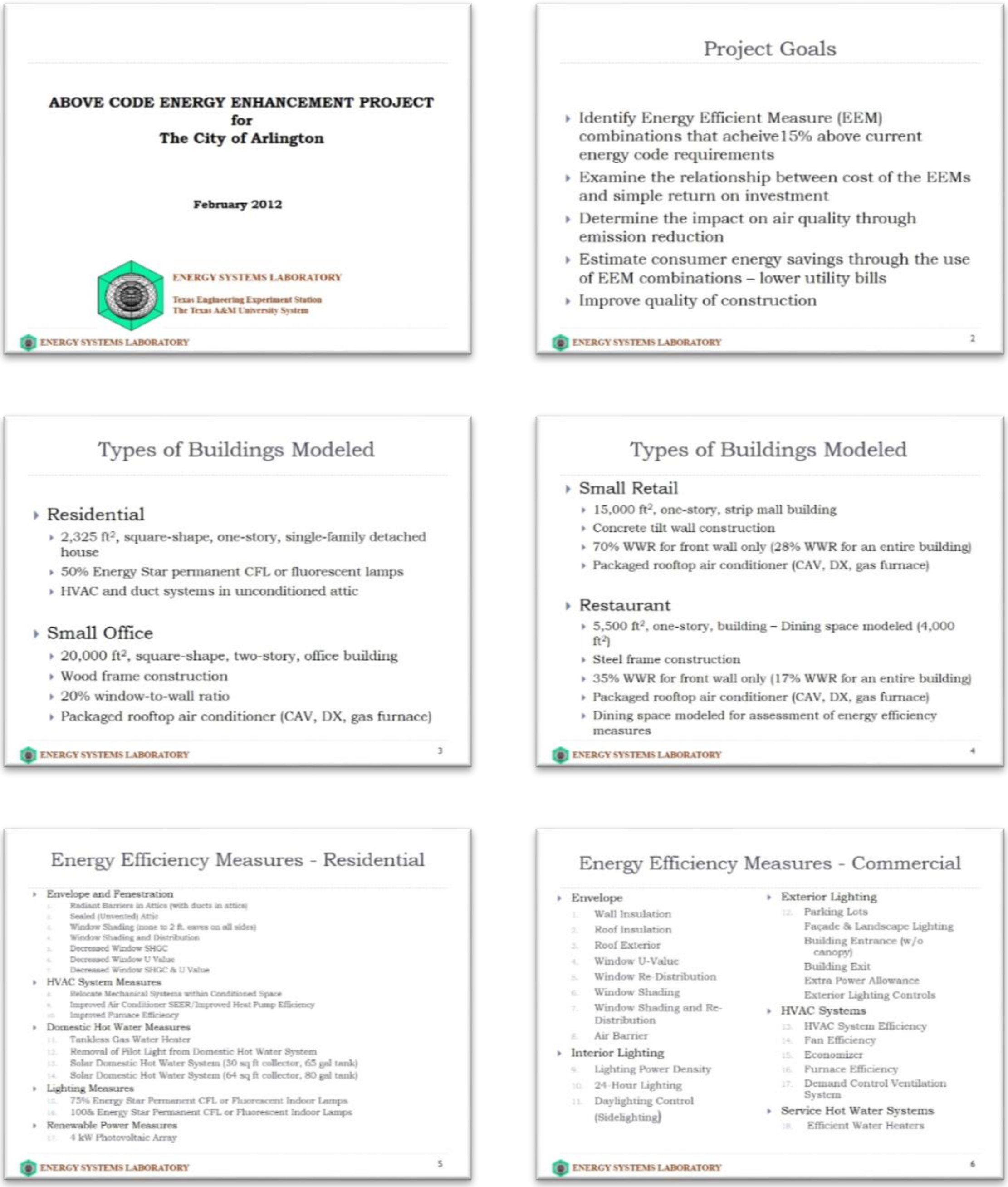
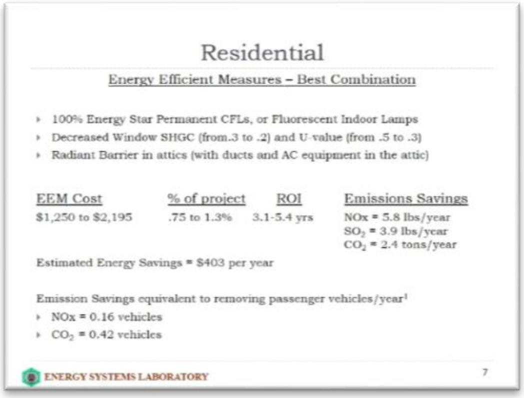
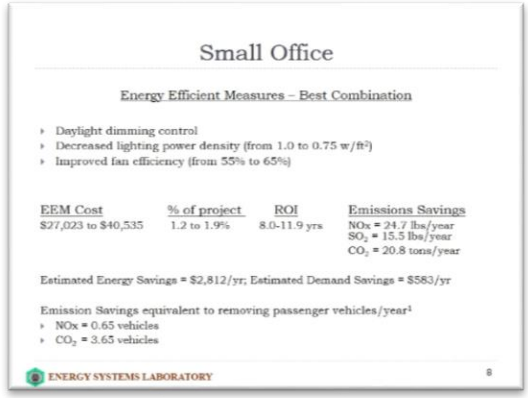
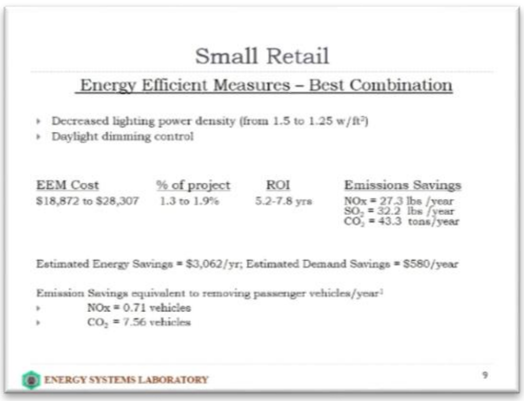
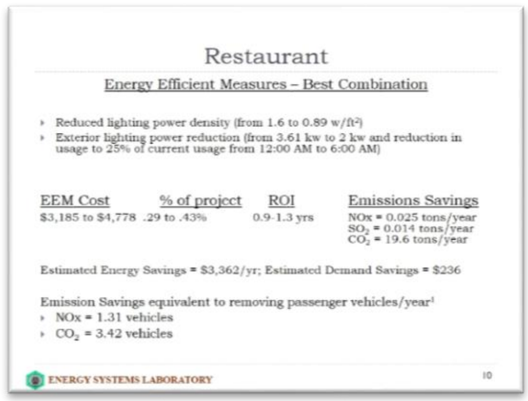


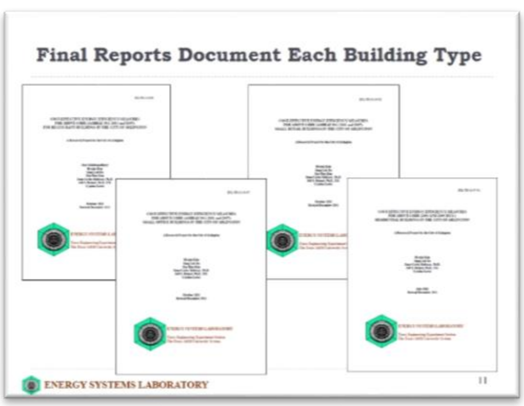
Figure 34: Presentation to the City of Arlington











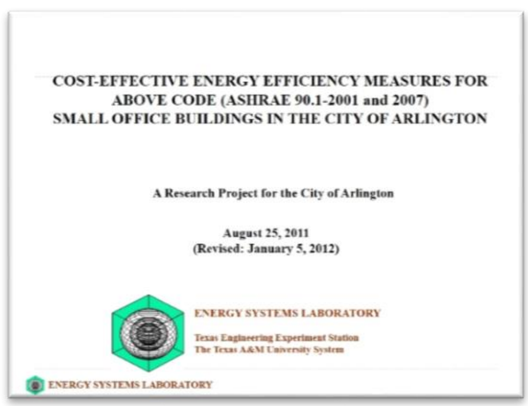
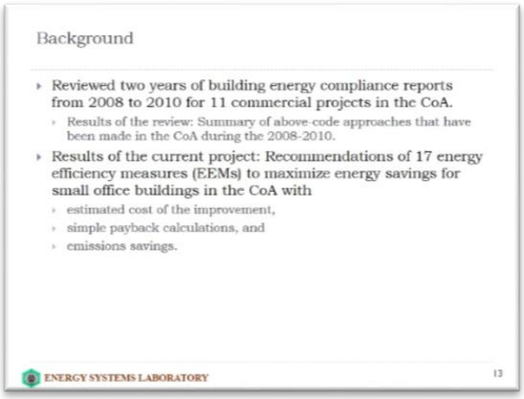
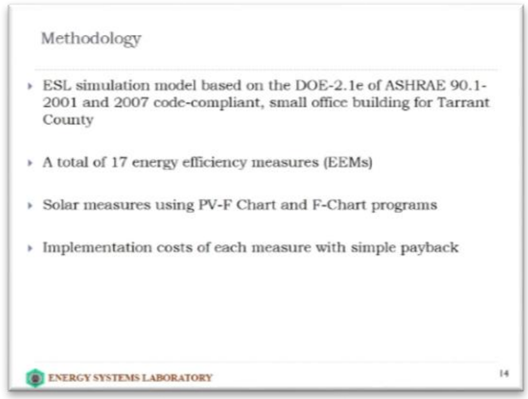
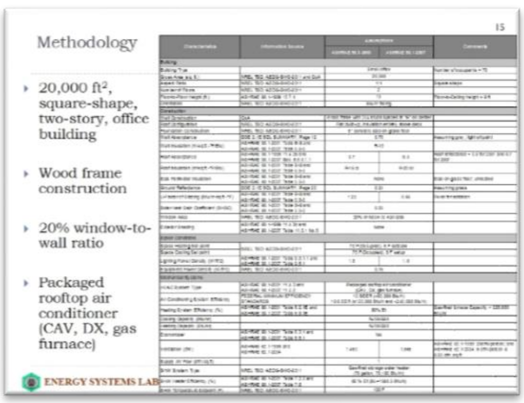
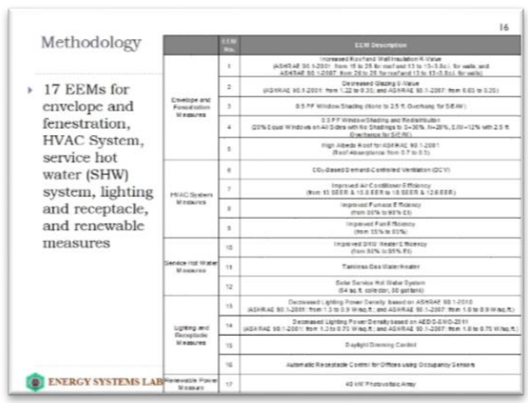


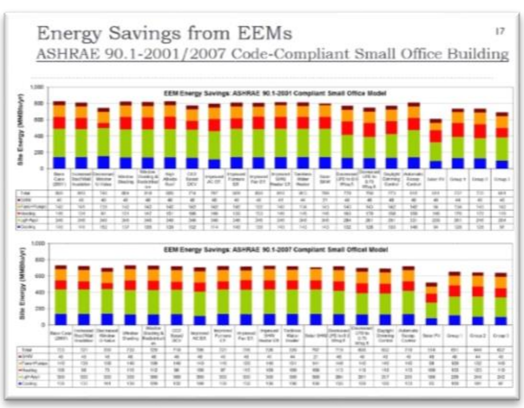
Figure 34: Presentation to the City of Arlington (Continued)











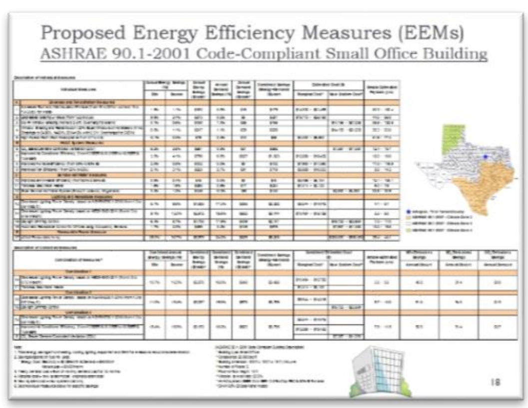
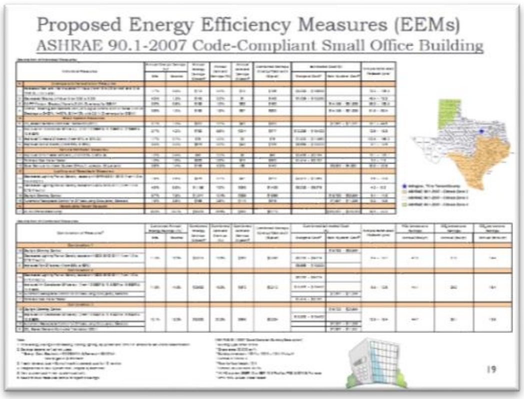
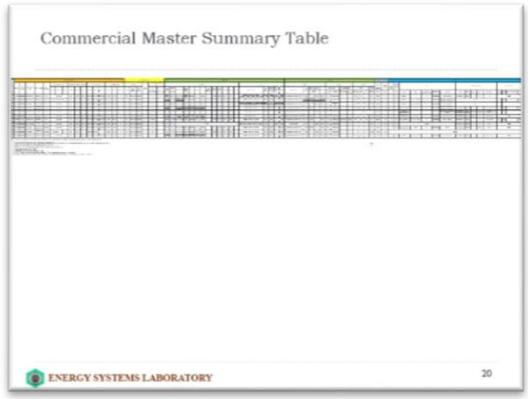
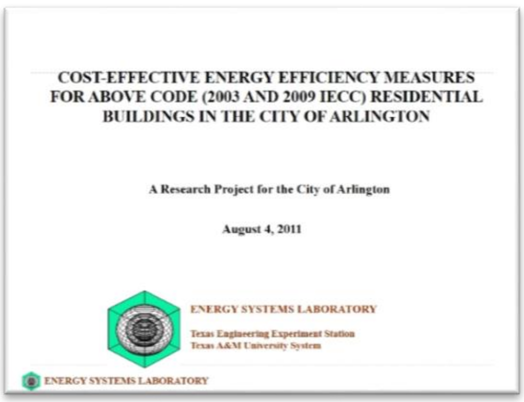
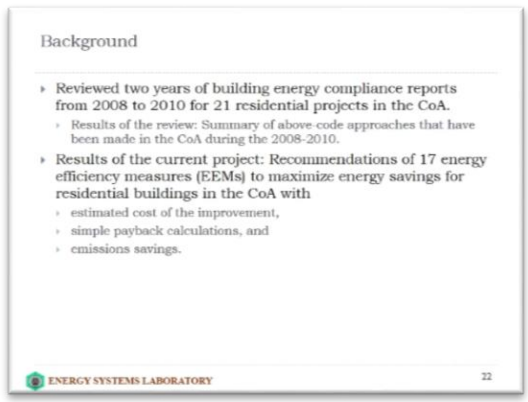


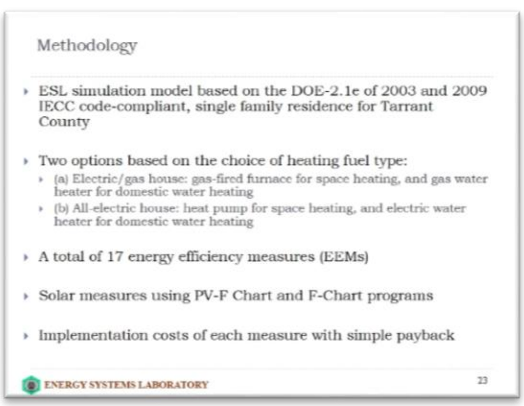
Figure 34: Presentation to the City of Arlington (Continued)











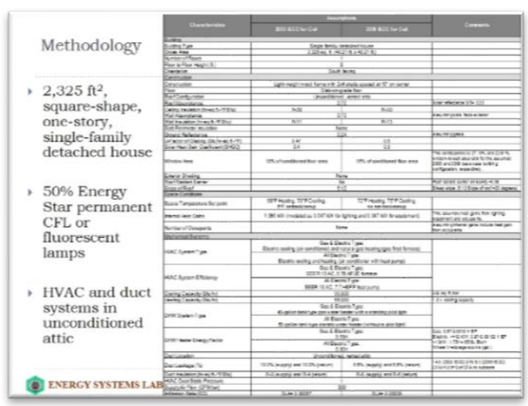
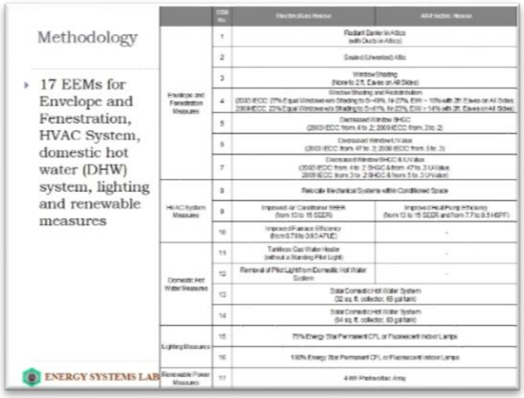
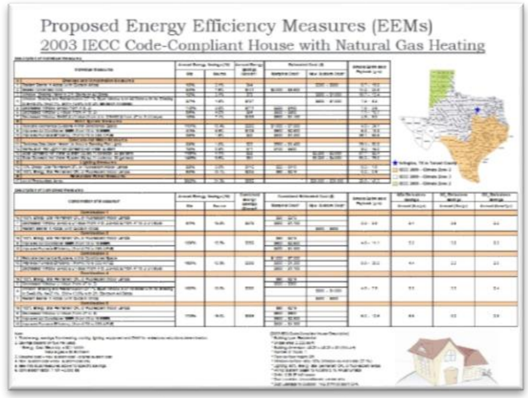
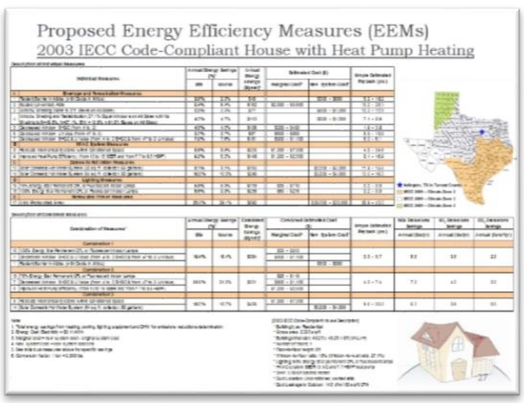
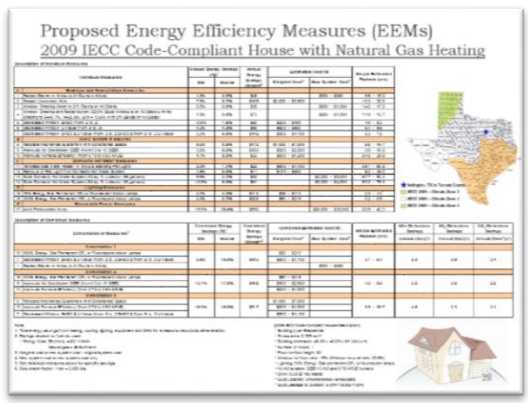


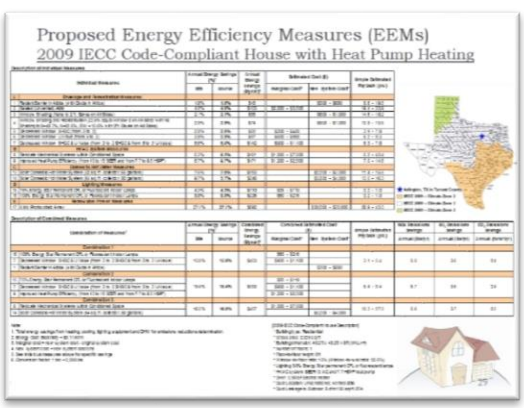
Figure 34: Presentation to the City of Arlington (Continued)











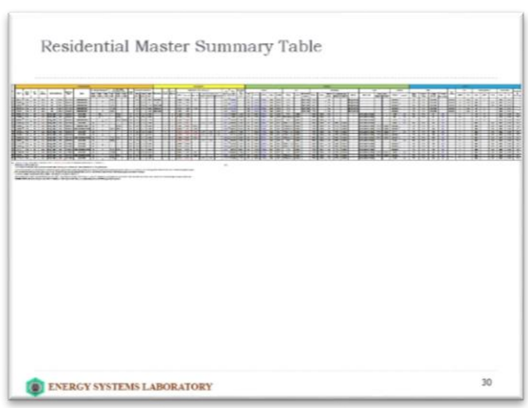


Figure 34: Presentation to the City of Arlington (Continued)

COST-EFFECTIVE ENERGY EFFICIENCY MEASURES FOR ABOVE CODE (ASHRAE 90.1-2001 and 2007) RESTAURANT BUILDINGS IN THE CITY OF ARLINGTON

A Research Project for the City of Arlington

October 2011
(Updated January 2012)

ENERGY SYSTEMS LABORATORY
Texas Engineering Experiment Station
Texas A&M University System

ENERGY SYSTEMS LABORATORY

Background

- Results of the current project: Recommendations of 18 energy efficiency measures (EEMs) to maximize energy savings for restaurant buildings in the CoA with
  - estimated cost of the improvement,
  - simple payback calculations, and
  - emissions savings.

ENERGY SYSTEMS LABORATORY 32

Methodology

- ESL simulation model based on the DOE-2.2 of ASHRAE 90.1-2001 and 2007 code-compliant, restaurant building for Tarrant County
- A total of 18 energy efficiency measures (EEMs) for ASHRAE 2001 base-case
- A total of 16 energy efficiency measures (EEMs) for ASHRAE 2007 base-case
- Implementation costs of each measure with simple payback

ENERGY SYSTEMS LABORATORY 33

Methodology

- 5,500 ft^2, one-story, building – Dining space modeled (4,000 ft^2)
- Steel frame construction
- 35% WWR for front wall only (17% WWR for an entire building)
- Packaged rooftop air conditioner (CAV, DX, gas furnace)

ENERGY SYSTEMS LABORATORY

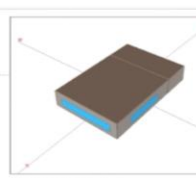
Methodology

- 5,500 ft^2, one-story, building – Dining space modeled (4,000 ft^2)
- Steel frame construction
- 35% WWR for front wall only (17% WWR for an entire building)
- Packaged rooftop air conditioner (CAV, DX, gas furnace)

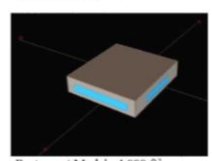
ENERGY SYSTEMS LABORATORY 35

Methodology

- Dining space modeled for assessment of energy efficiency measures



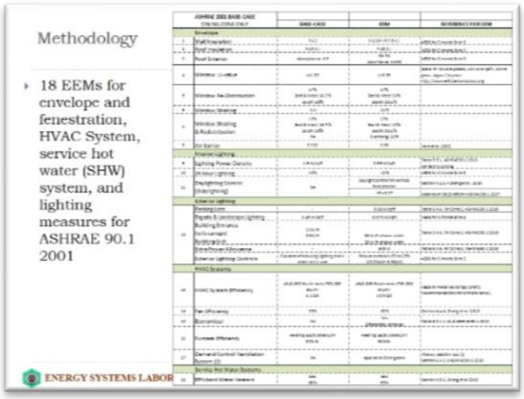
Restaurant: 5,500 ft^2

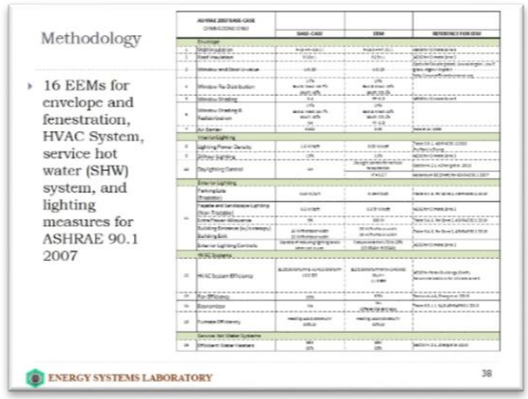


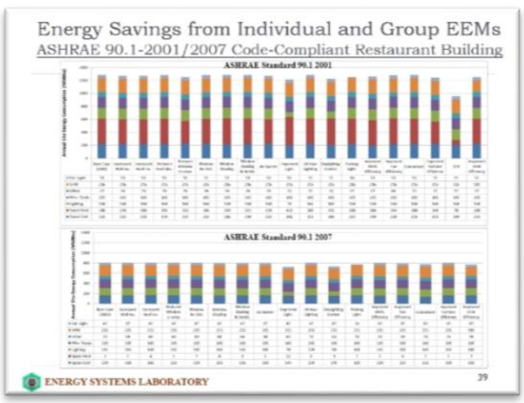
Restaurant Model : 4,000 ft^2

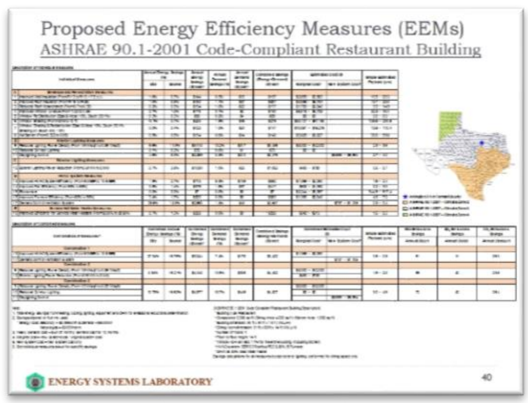
ENERGY SYSTEMS LABORATORY 36

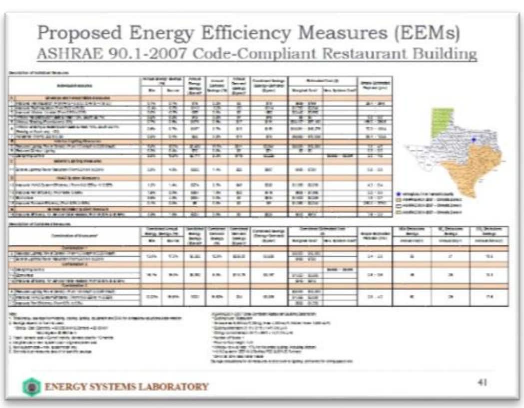
Figure 34: Presentation to the City of Arlington (Continued)











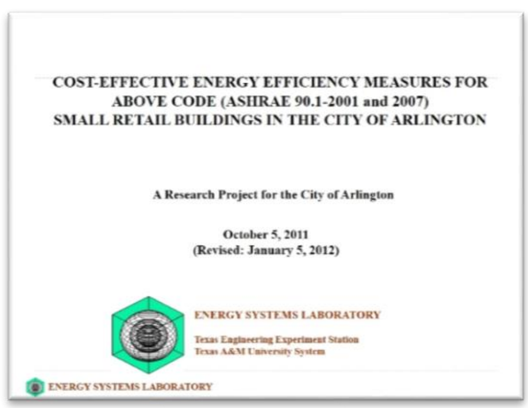
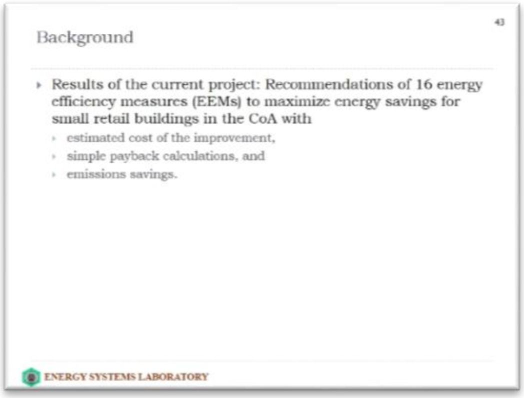
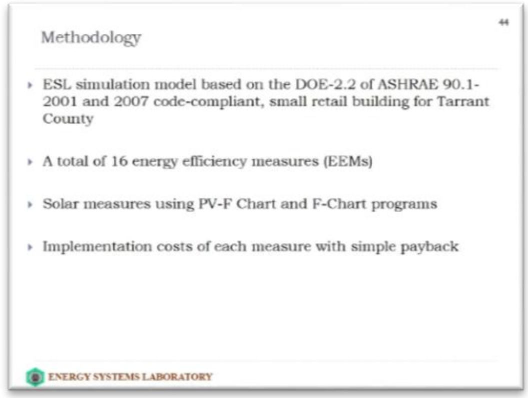
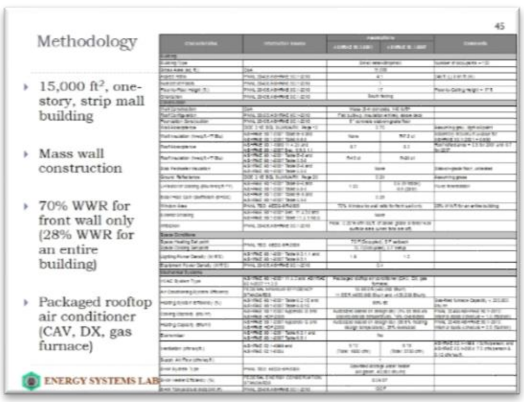
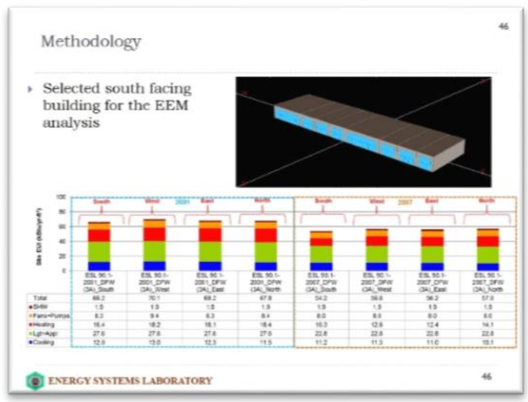


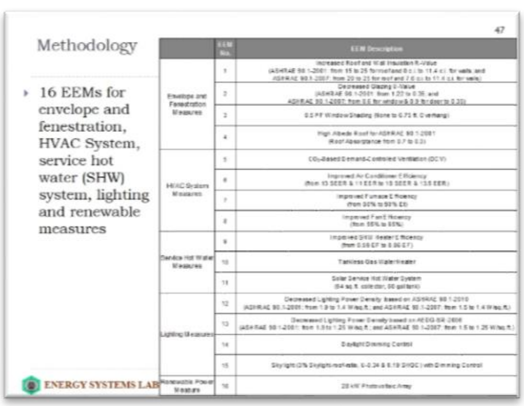
Figure 34: Presentation to the City of Arlington (Continued)











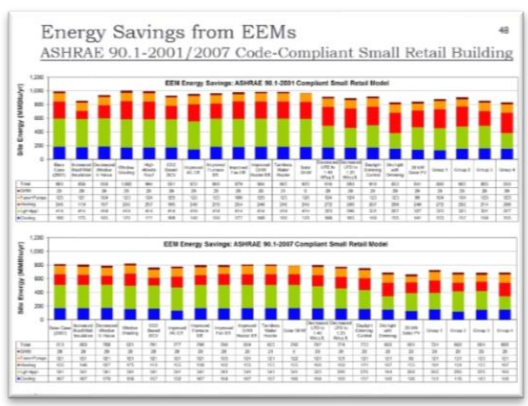
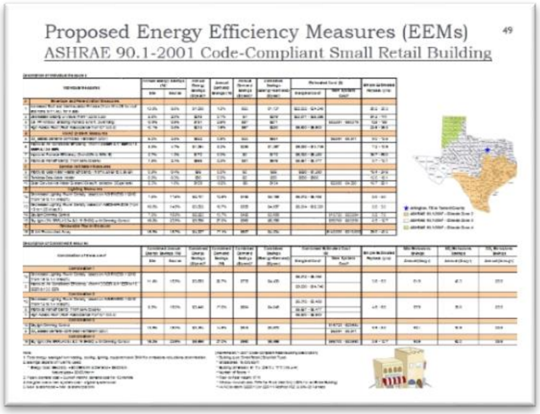


Figure 34: Presentation to the City of Arlington (Continued)



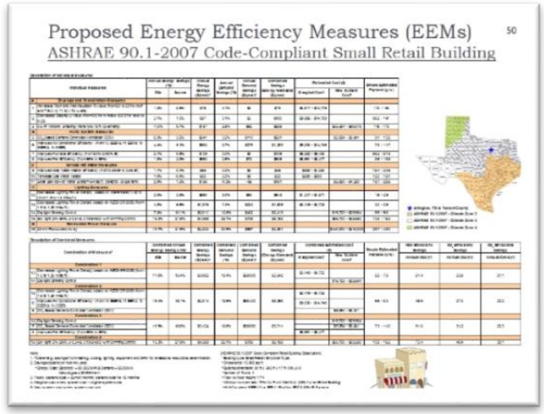
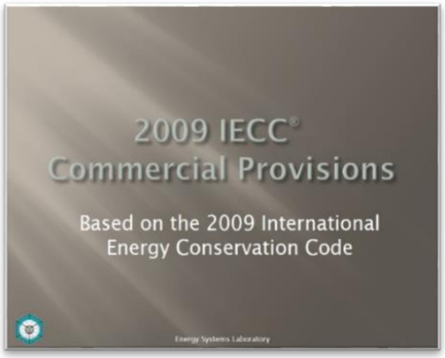
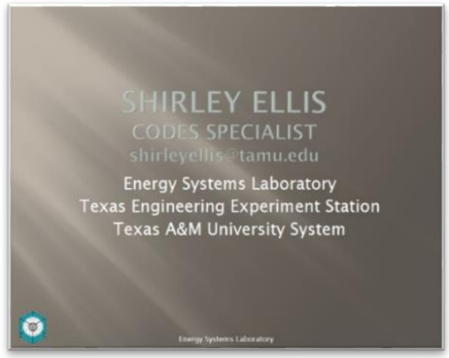
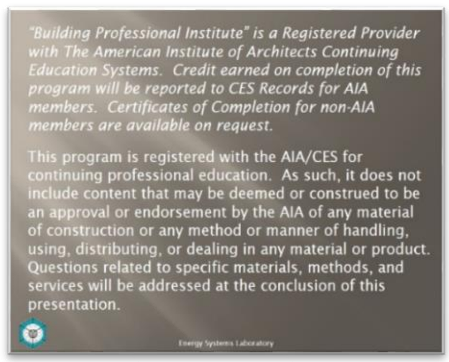


Figure 34: Presentation to the City of Arlington (Continued)

Presentations to BPI , February 2012







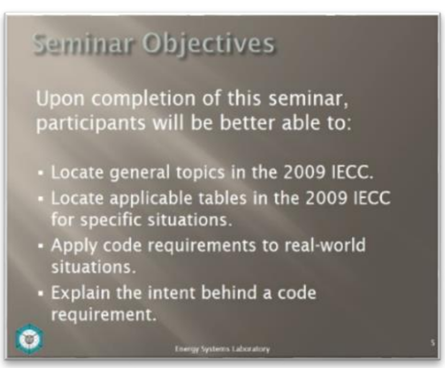
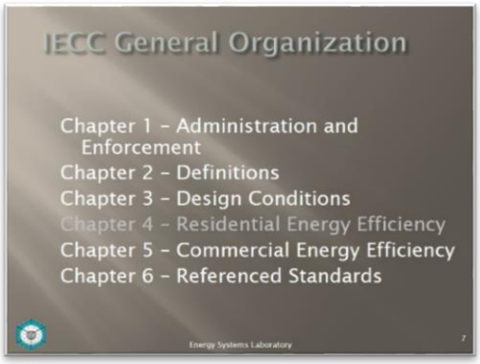
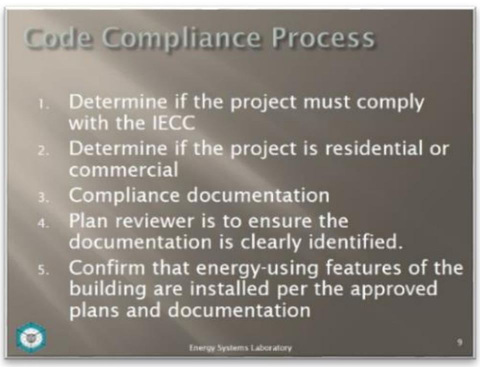
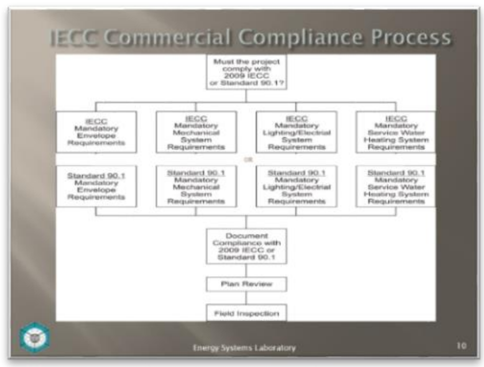


Figure 35: Presentations to BPI, February 2012 (continued)







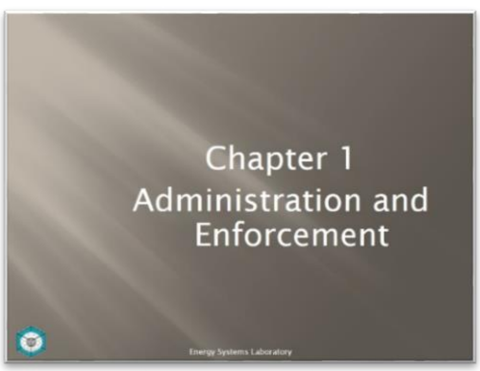
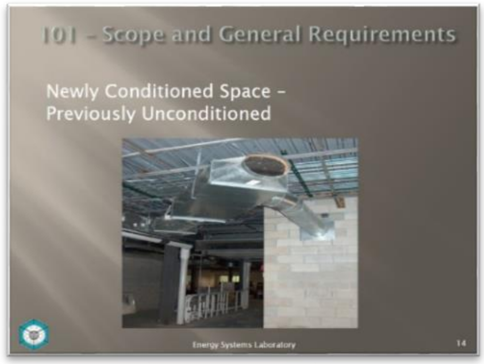
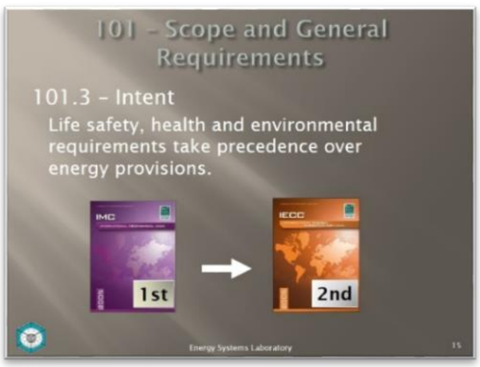


Figure 35: Presentations to BPI, February 2012 (continued)





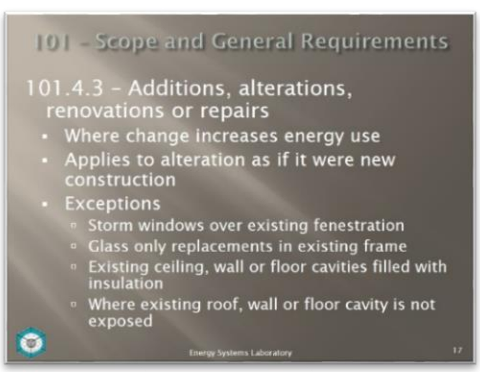
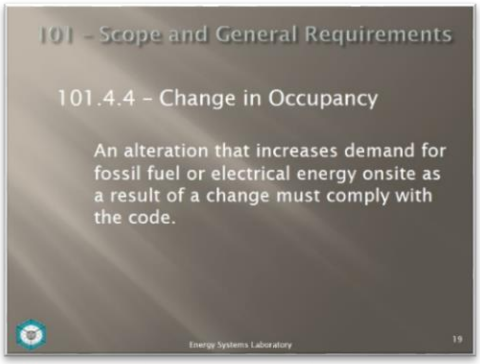
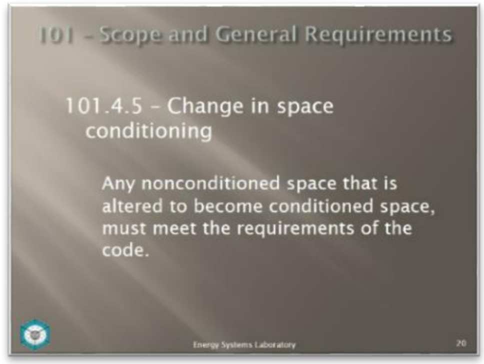
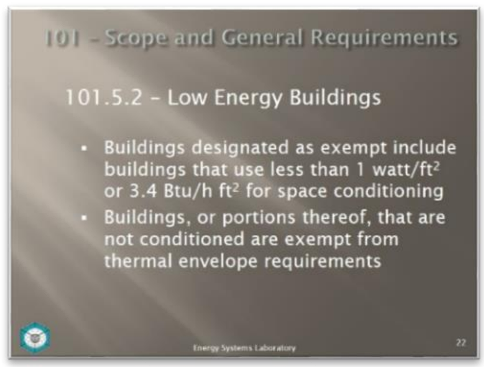
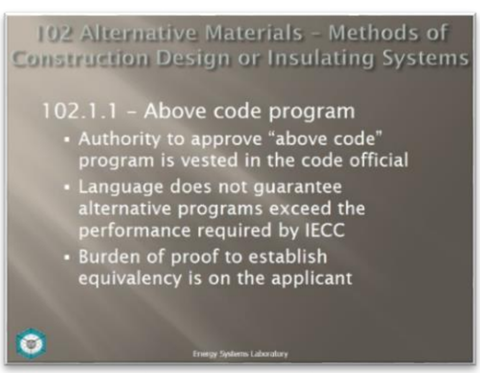


Figure 35: Presentations to BPI, February 2012 (continued)









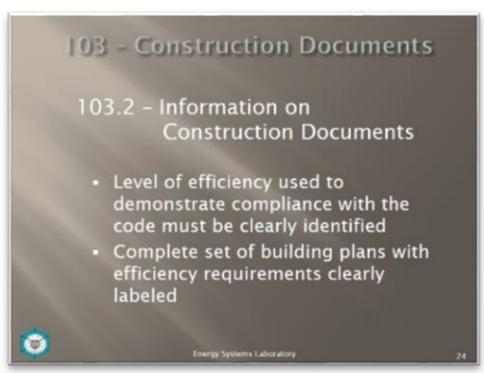
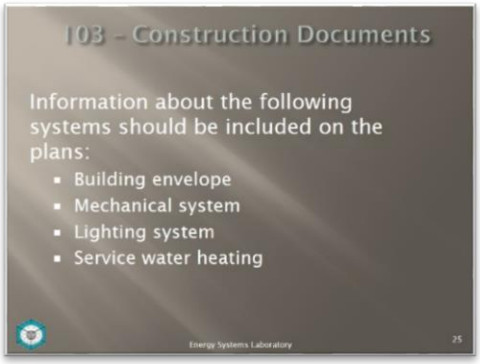


Figure 35: Presentations to BPI, February 2012 (continued)


103 – Construction Documents
Information about the following systems should be included on the plans:
Building envelope
Mechanical system
Lighting system
Service water heating
Energy Systems Laboratory
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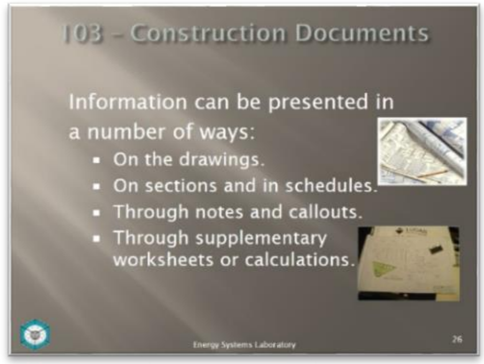
103 – Construction Documents
Information can be presented in a number of ways:
On the drawings.
On sections and in schedules.
Through notes and callouts.
Through supplementary worksheets or calculations.
Energy Systems Laboratory
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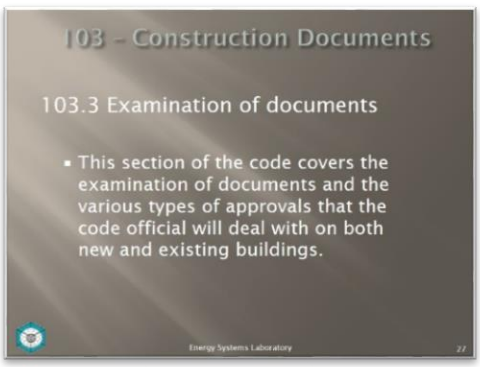
103 – Construction Documents
103.3 Examination of documents
This section of the code covers the examination of documents and the various types of approvals that the code official will deal with on both new and existing buildings.
Energy Systems Laboratory
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104 - Inspections
The code states:
All construction is subject to inspection.
Construction shall not be concealed without inspection approval.
A final inspection is required before occupancy.
A building shall be re-inspected when determined necessary by the code official.
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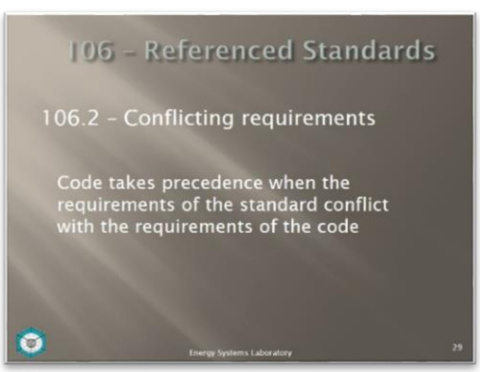
106 – Referenced Standards
106.2 – Conflicting requirements
Code takes precedence when the requirements of the standard conflict with the requirements of the code
Energy Systems Laboratory
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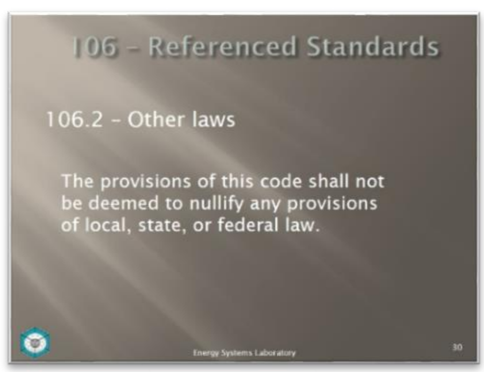
106 – Referenced Standards
106.2 – Other laws
The provisions of this code shall not be deemed to nullify any provisions of local, state, or federal law.
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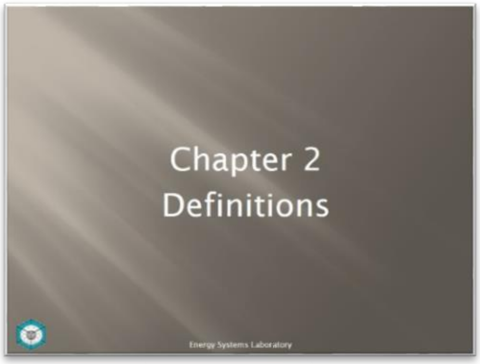
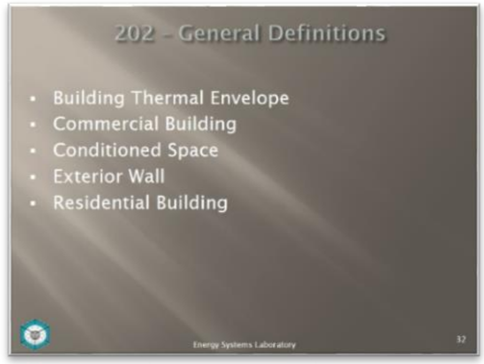
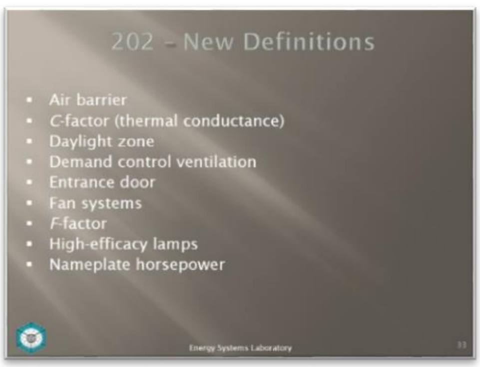
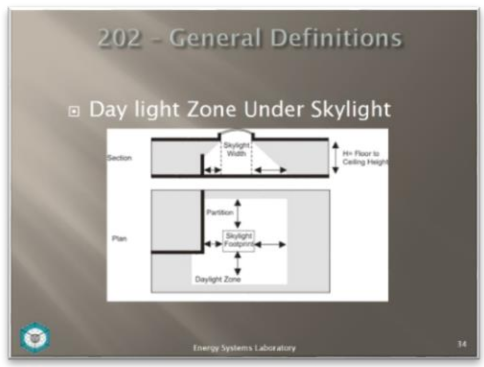
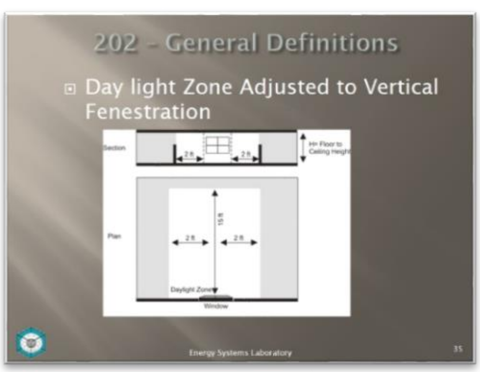
Figure 35: Presentations to BPI, February 2012 (continued)











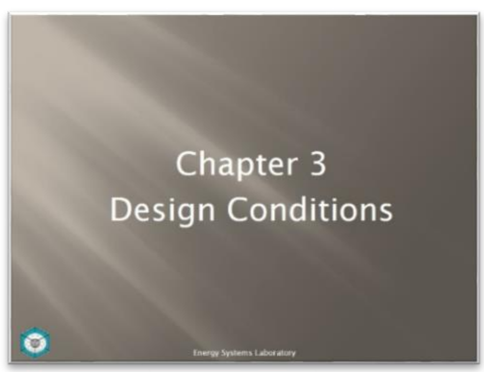
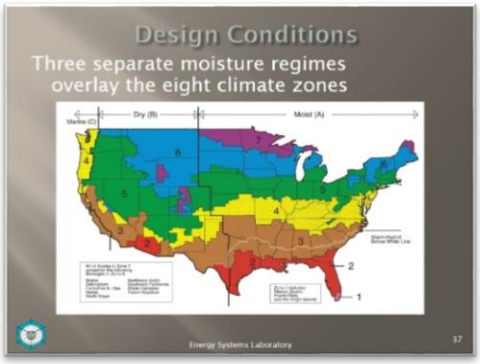
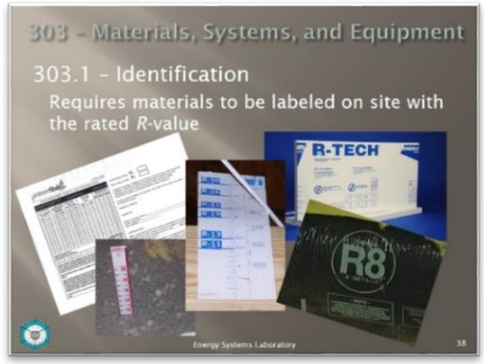
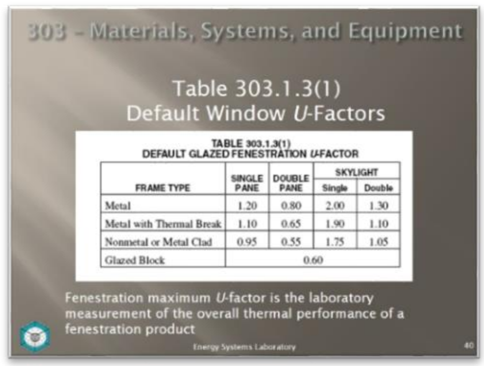
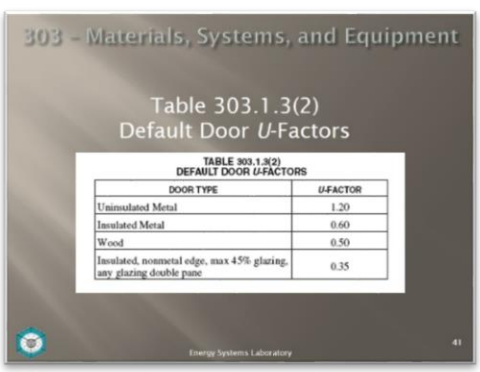


Figure 35: Presentations to BPI, February 2012 (continued)









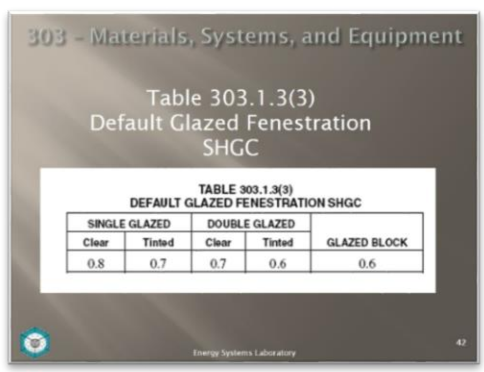
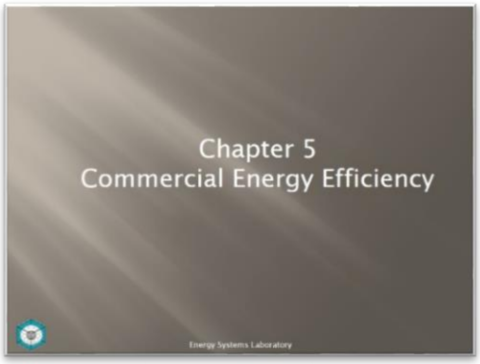


Figure 35: Presentations to BPI, February 2012 (continued)



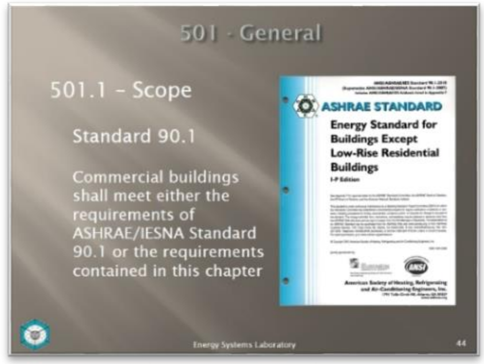
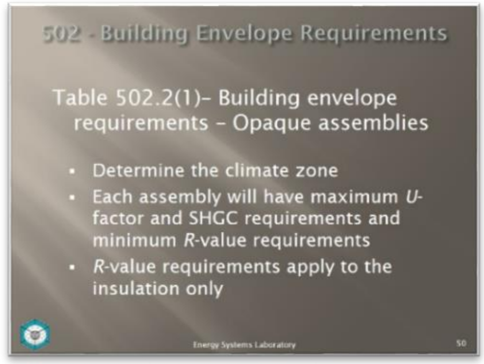
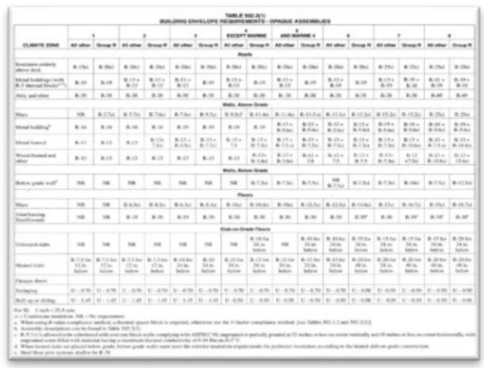


Figure 35: Presentations to BPI, February 2012 (continued)





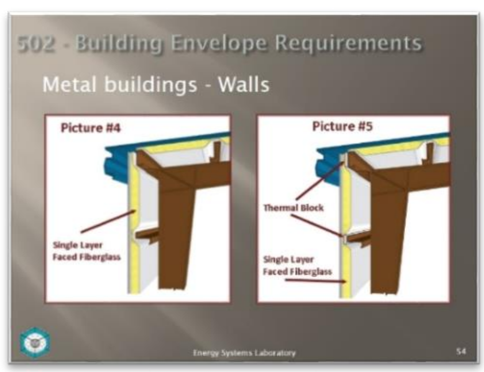


Figure 35: Presentations to BPI, February 2012 (continued)

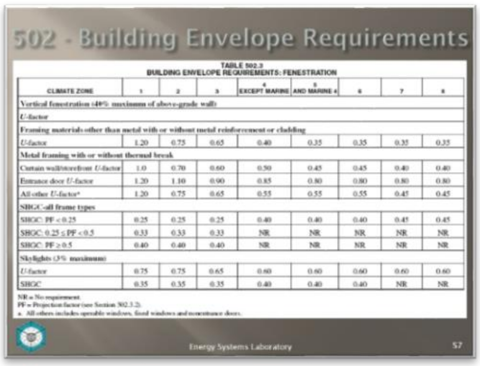


TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration (40% maximum of above-grade wall)								
U-factor								
Framing materials other than metal with or without metal reinforcement or cladding								
U-factor	1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35
Metal framing with or without thermal break								
Curtain wall/storefront *U*-factor	1.0	0.70	0.60	0.50	0.45	0.45	0.40	0.40
Entrance door *U*-factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All other *U*-factor[a]	1.20	0.75	0.65	0.55	0.55	0.55	0.45	0.45
SHGC-all frame types								
SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
SHGC: 0.25 ≤ PF < 0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
Skylights (3% maximum)								
U-factor	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.
PF = Projection factor (see Section 502.3.2).
a. All others includes operable windows, fixed windows and nonentrance doors.

Figure 35: Presentations to BPI, February 2012 (continued)

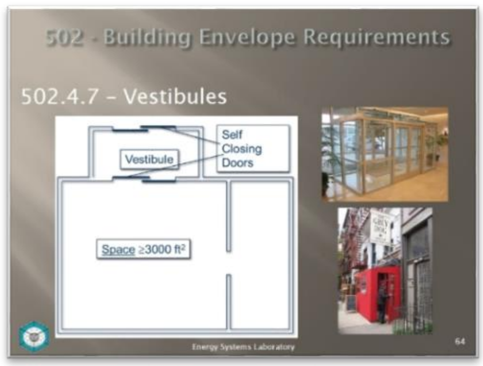
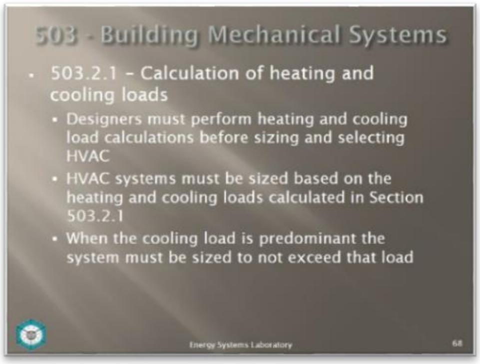
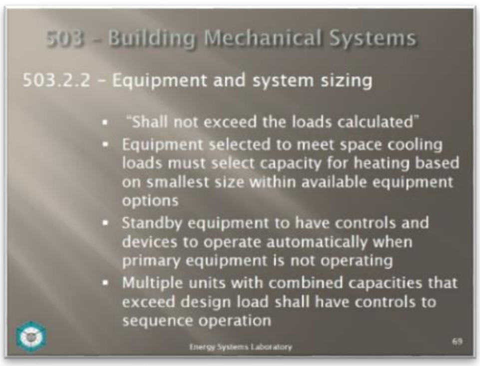
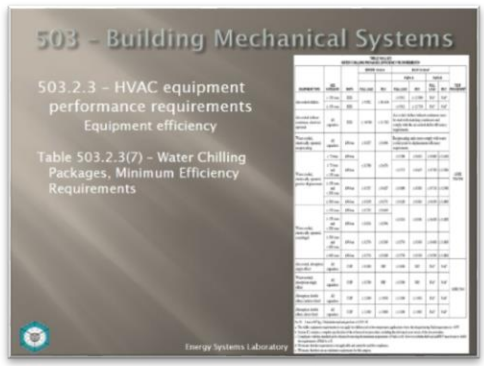


Figure 35: Presentations to BPI, February 2012 (continued)







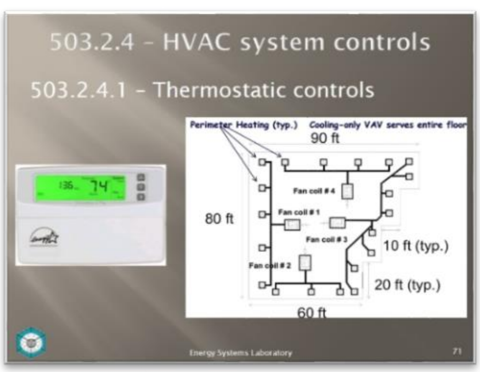
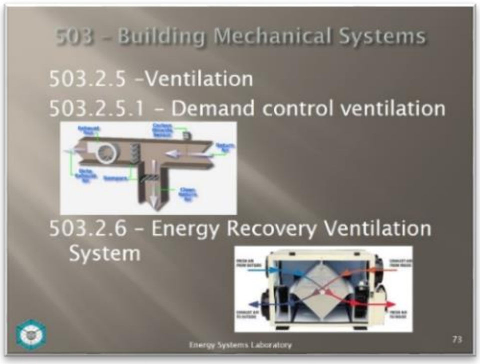


Figure 35: Presentations to BPI, February 2012 (continued)



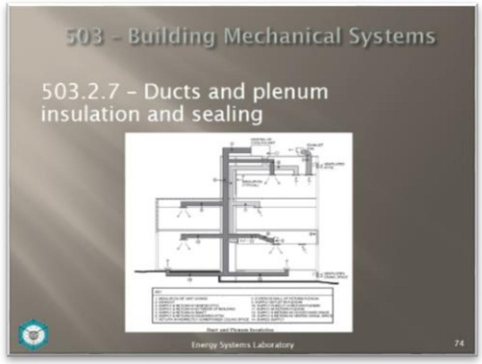
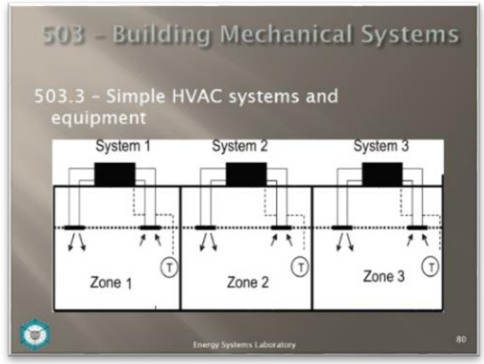
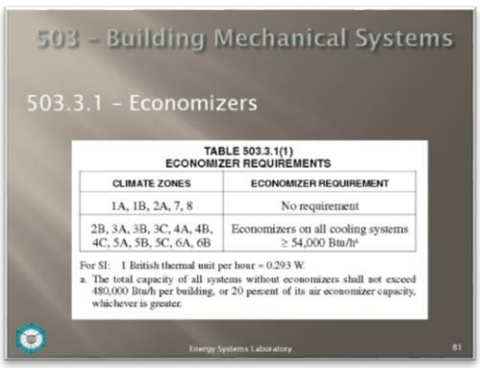
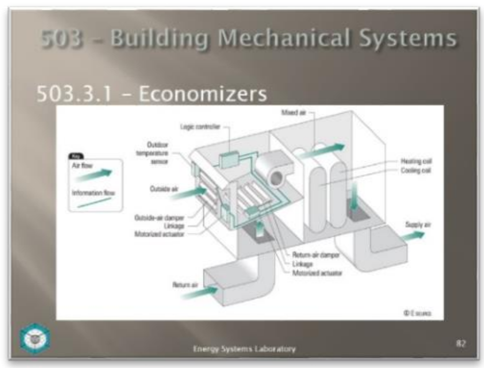


Figure 35: Presentations to BPI, February 2012 (continued)







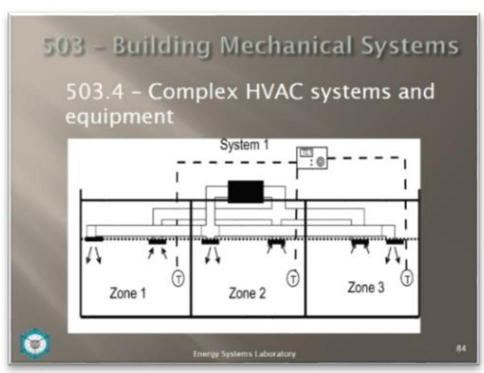
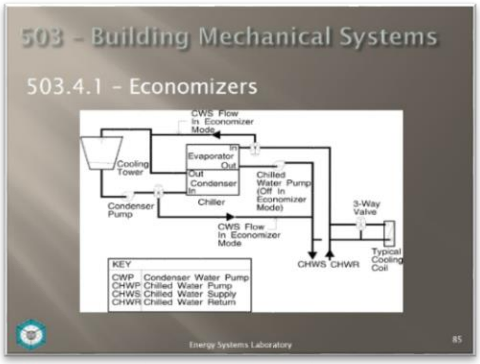
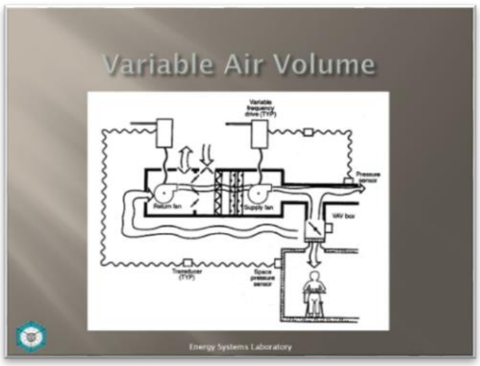
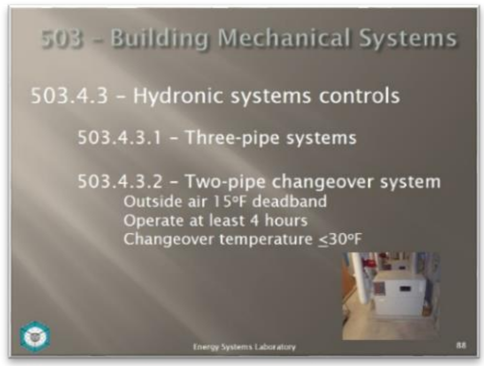


Figure 35: Presentations to BPI, February 2012 (continued)







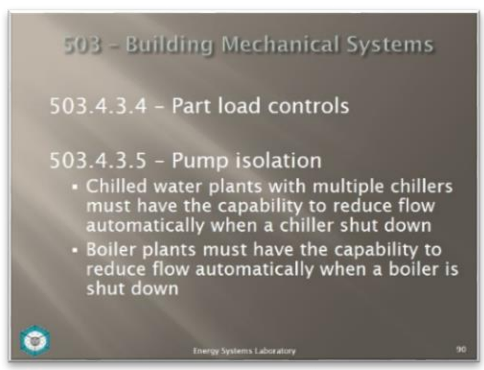


Figure 35: Presentations to BPI, February 2012 (continued)

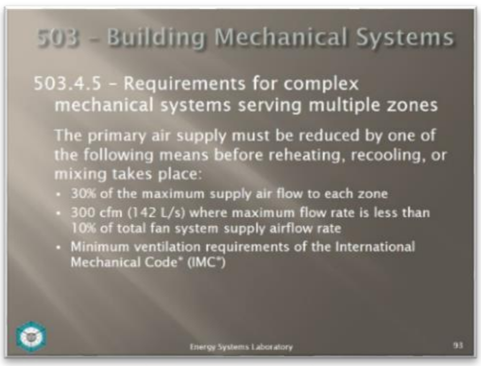


Figure 35: Presentations to BPI, February 2012 (continued)

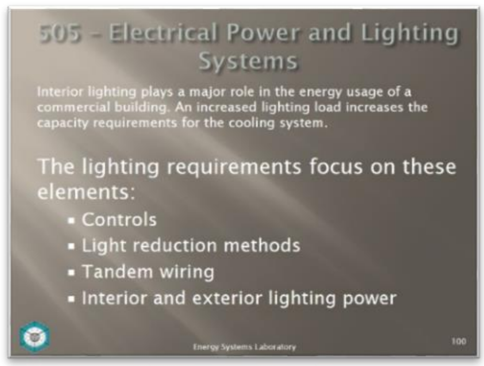
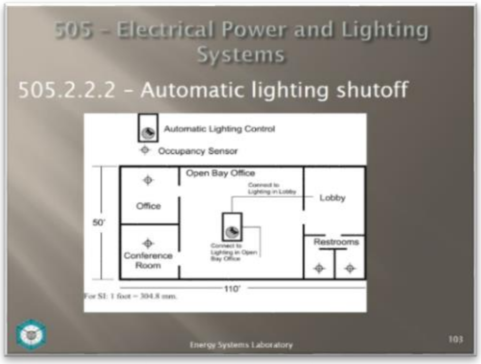
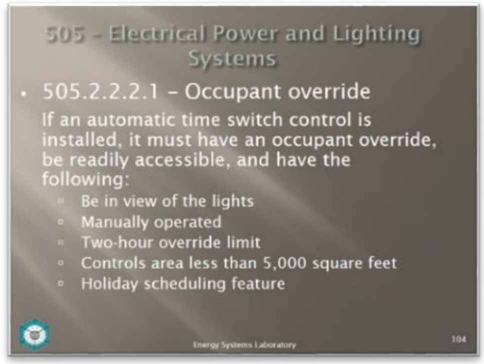


Figure 35: Presentations to BPI, February 2012 (continued)





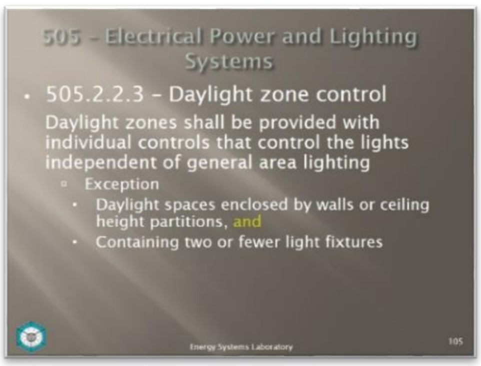


Figure 35: Presentations to BPI, February 2012 (continued)

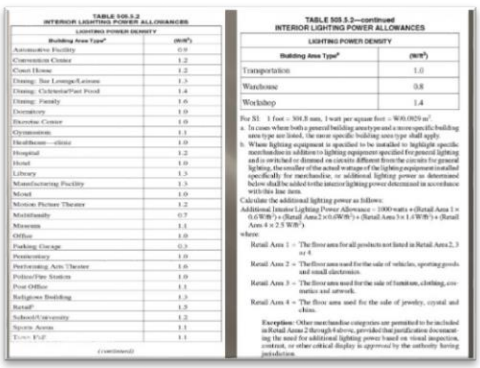


TABLE 505.5.2
INTERIOR LIGHTING POWER ALLOWANCES

LIGHTING POWER DENSITY	
Building Area Type[a]	(W/ft²)
Automotive Facility	0.9
Convention Center	1.2
Court House	1.2
Dining: Bar Lounge/Leisure	1.3
Dining: Cafeteria/Fast Food	1.4
Dining: Family	1.6
Dormitory	1.0
Exercise Center	1.0
Gymnasium	1.1
Healthcare—clinic	1.0
Hospital	1.2
Hotel	1.0
Library	1.3
Manufacturing Facility	1.3
Motel	1.0
Motion Picture Theater	1.2
Multifamily	0.7
Museum	1.1
Office	1.0
Parking Garage	0.3
Penitentiary	1.0
Performing Arts Theater	1.6
Police/Fire Station	1.0
Post Office	1.1
Religious Building	1.3
Retail[b]	1.5
School/University	1.2
Sports Arena	1.1
Town Hall	1.1

(continued)

TABLE 505.5.2—continued
INTERIOR LIGHTING POWER ALLOWANCES

LIGHTING POWER DENSITY	
Building Area Type[a]	(W/ft²)
Transportation	1.0
Warehouse	0.8
Workshop	1.4

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m².

a. In cases where both a general building area type and a more specific building area type are listed, the more specific building area type shall apply.

b. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or additional lighting power as determined below shall be added to the interior lighting power determined in accordance with this line item.

Calculate the additional lighting power as follows:

Additional Interior Lighting Power Allowance = 1000 watts + (Retail Area 1 × 0.6 W/ft²) + (Retail Area 2 × 0.6 W/ft²) + (Retail Area 3 × 1.4 W/ft²) + (Retail Area 4 × 2.5 W/ft²)

where:

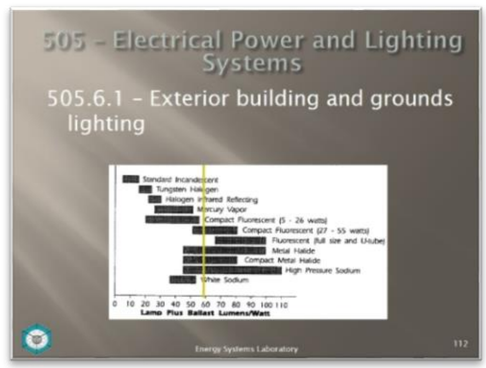
Retail Area 1 = The floor area for all products not listed in Retail Area 2, 3 or 4.

Retail Area 2 = The floor area used for the sale of vehicles, sporting goods and small electronics.

Retail Area 3 = The floor area used for the sale of furniture, clothing, cosmetics and artwork.

Retail Area 4 = The floor area used for the sale of jewelry, crystal and china.

Exception: Other merchandise categories are permitted to be included in Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is *approved* by the authority having jurisdiction.



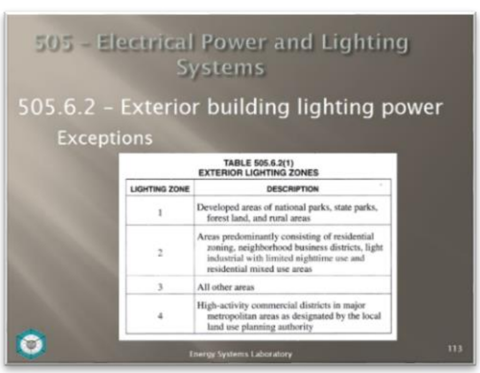


TABLE 505.6.2(1)
EXTERIOR LIGHTING ZONES

LIGHTING ZONE	DESCRIPTION
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas
3	All other areas
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

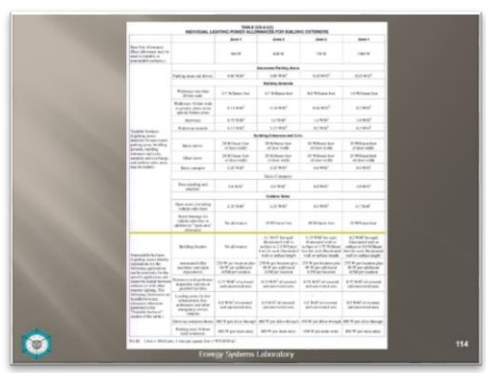
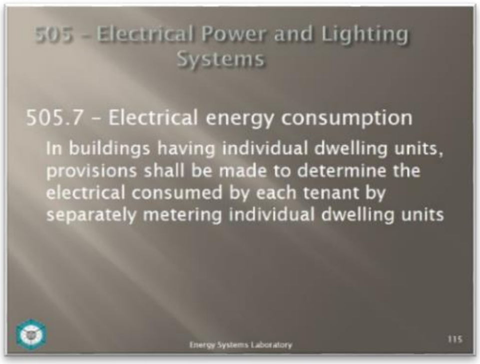
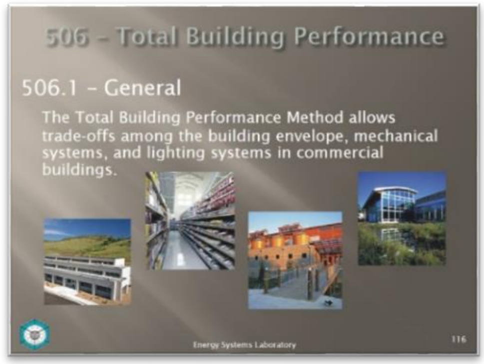
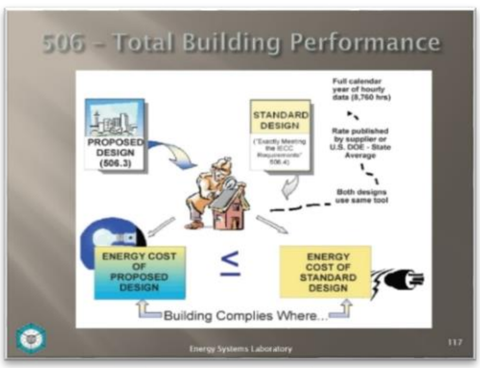


Figure 35: Presentations to BPI, February 2012 (continued)







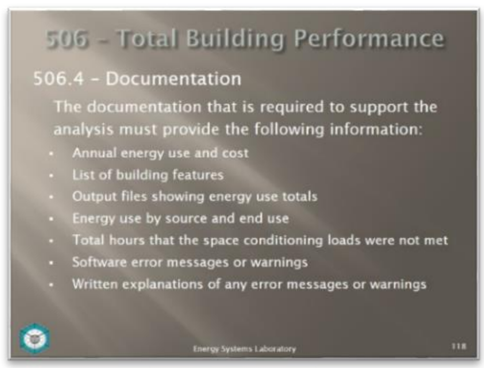
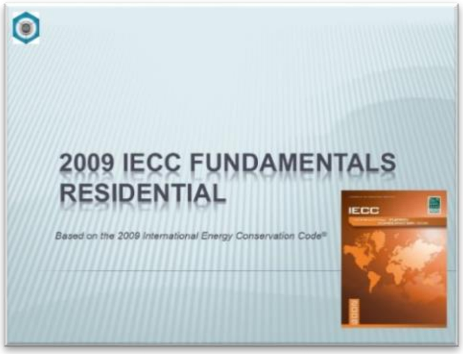
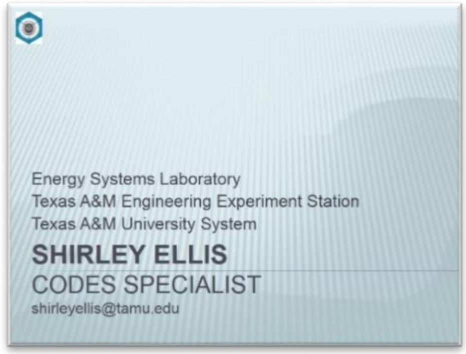
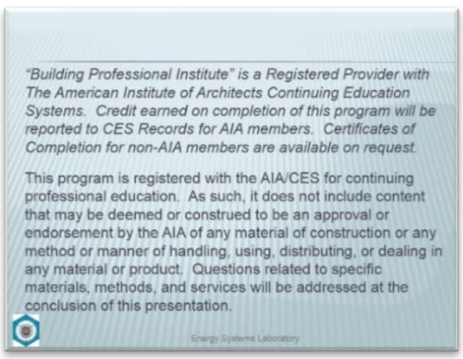
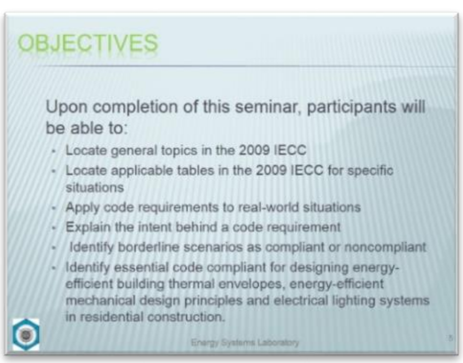


Figure 35: Presentations to BPI, February 2012 (continued)









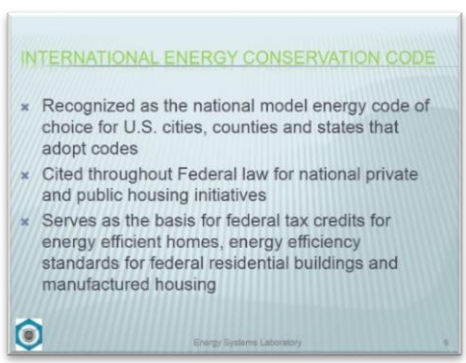
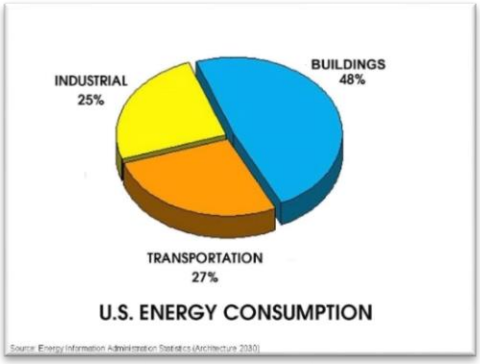
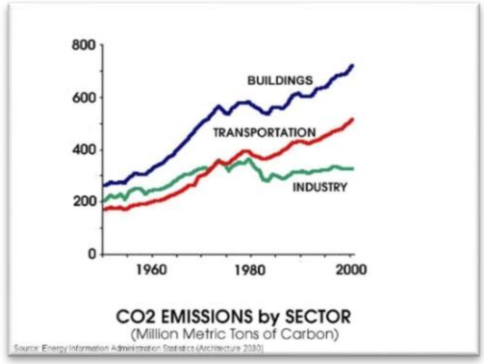
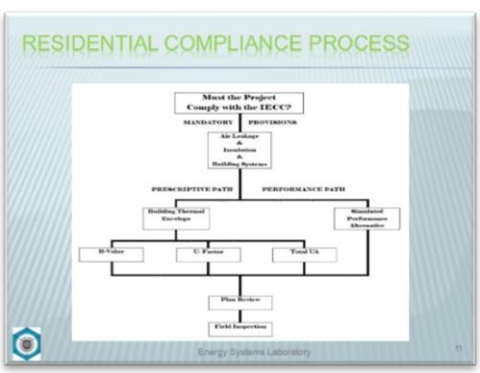


Figure 35: Presentations to BPI, February 2012 (continued)







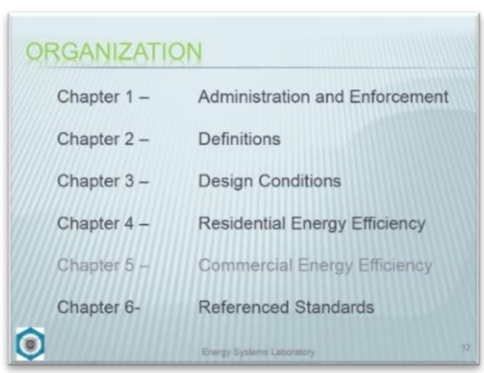
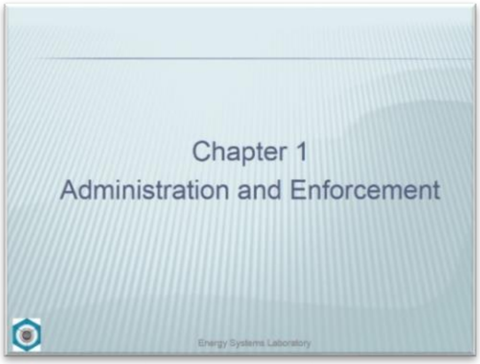


Figure 35: Presentations to BPI, February 2012 (continued)



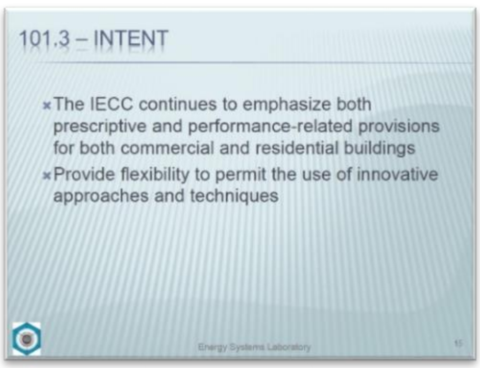
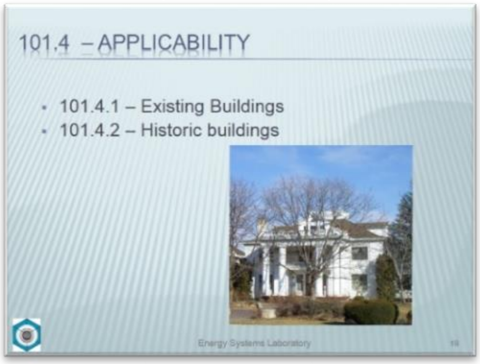
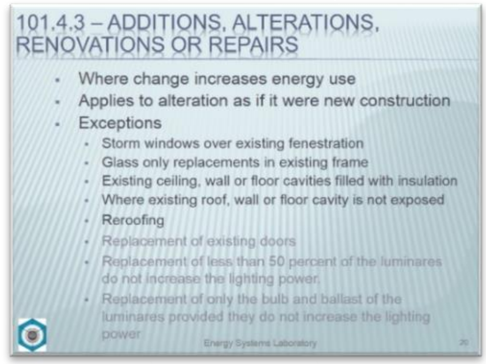
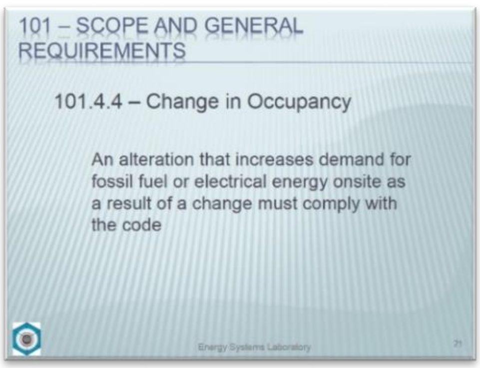
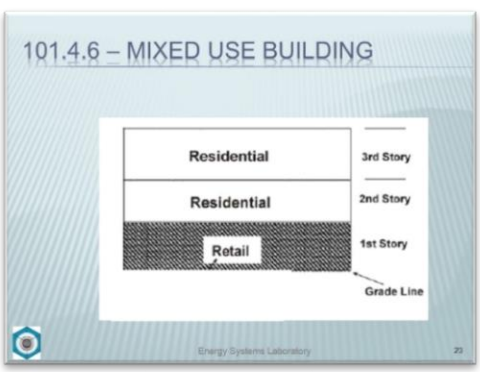


Figure 35: Presentations to BPI, February 2012 (continued)









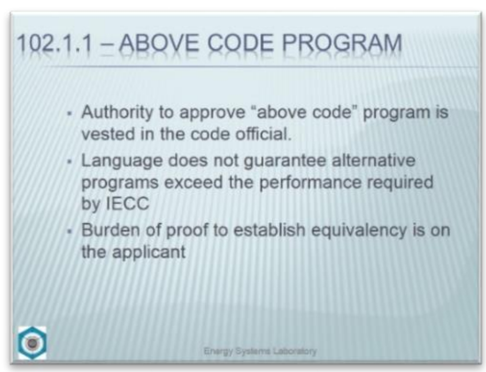
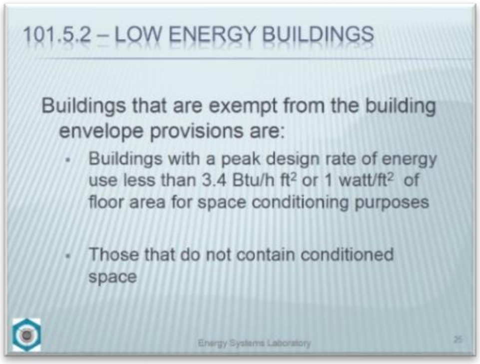
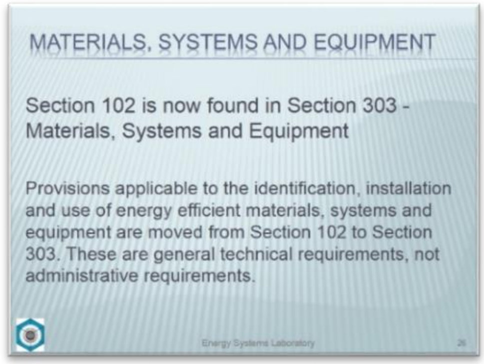
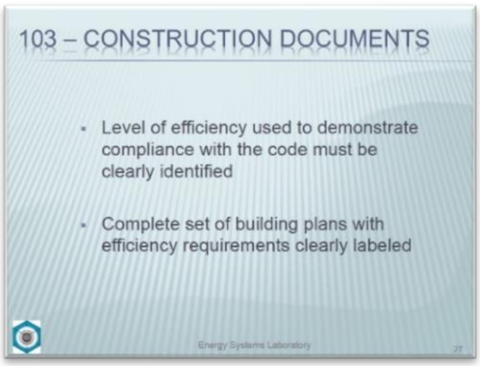
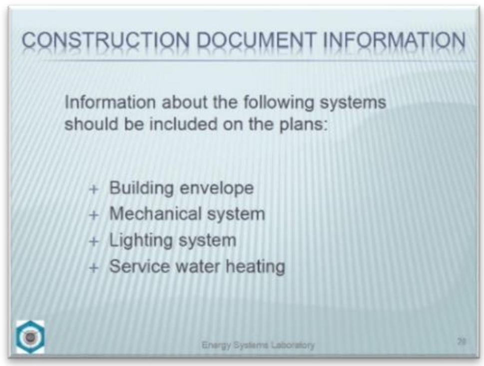


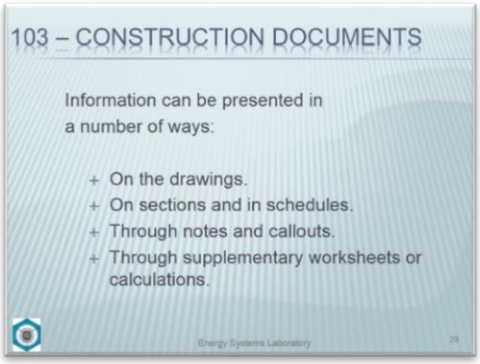
Figure 35: Presentations to BPI, February 2012 (continued)











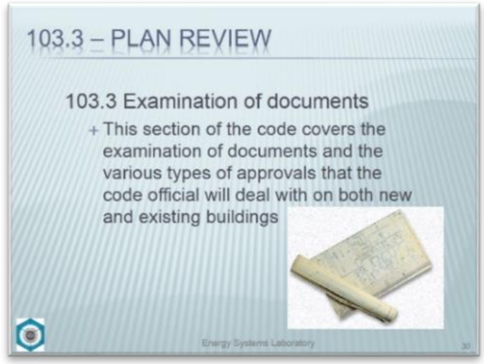
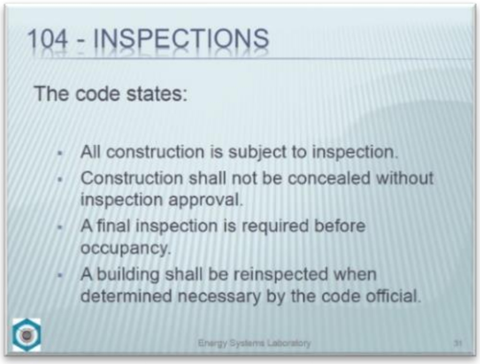
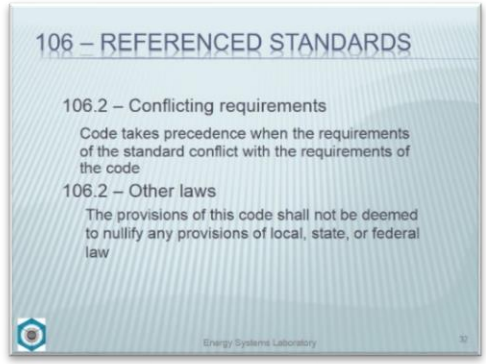
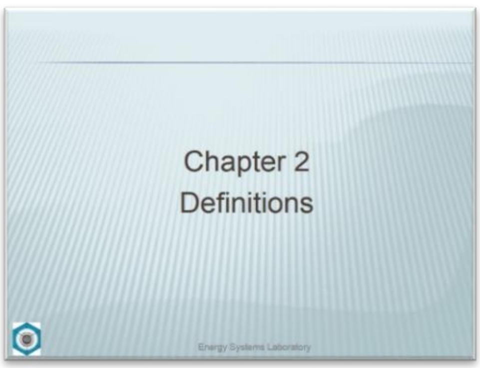
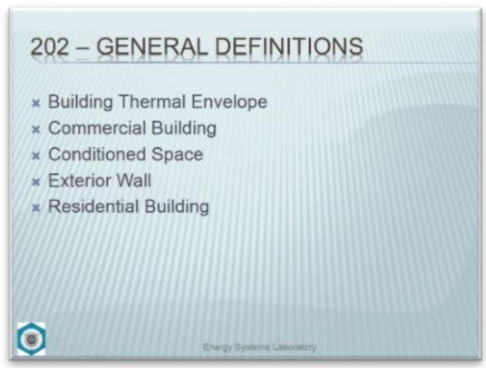


Figure 35: Presentations to BPI, February 2012 (continued)









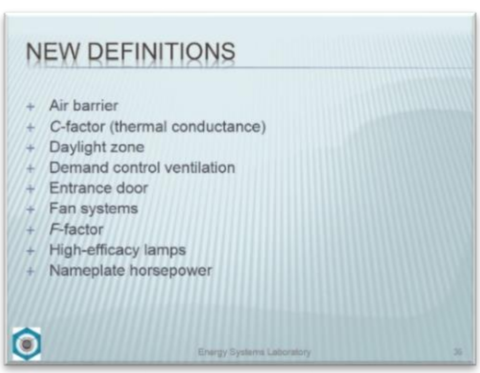
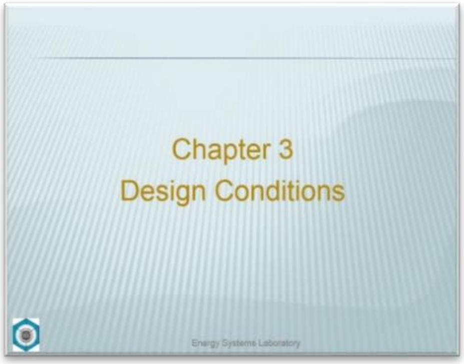
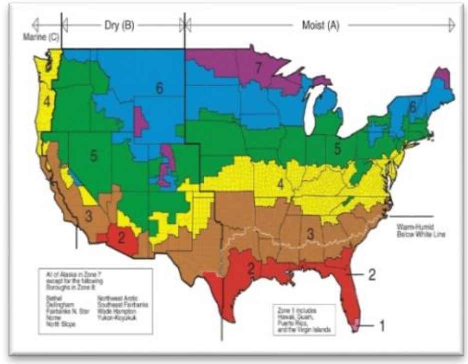
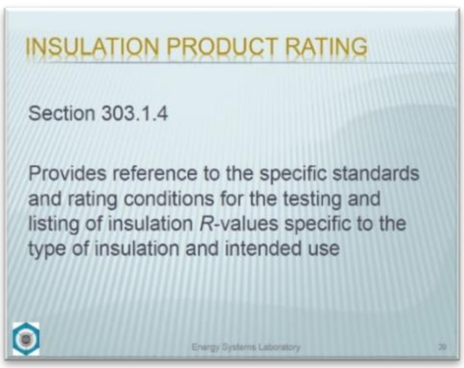
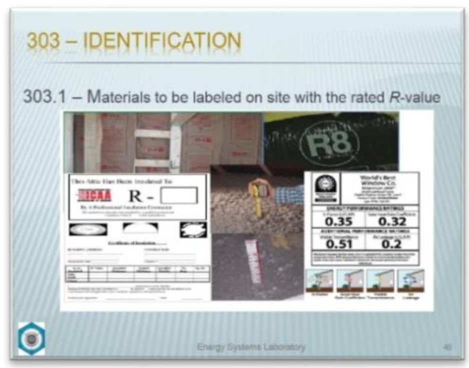


Figure 35: Presentations to BPI, February 2012 (continued)









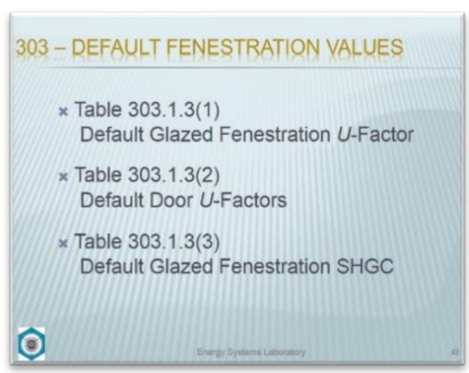


Figure 35: Presentations to BPI, February 2012 (continued)

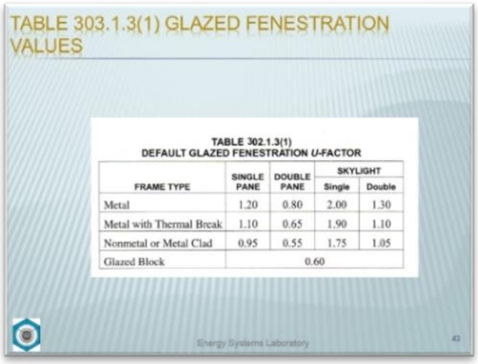


TABLE 302.1.3(1)
DEFAULT GLAZED FENESTRATION *U*-FACTOR

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

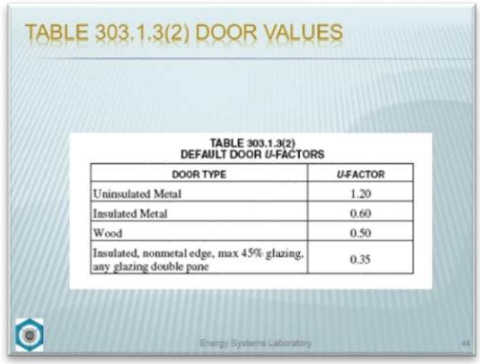


TABLE 303.1.3(2)
DEFAULT DOOR *U*-FACTORS

DOOR TYPE	*U*-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

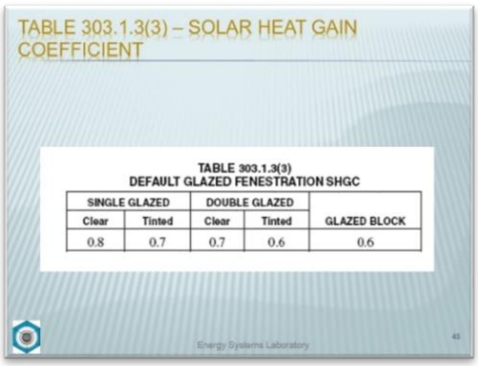
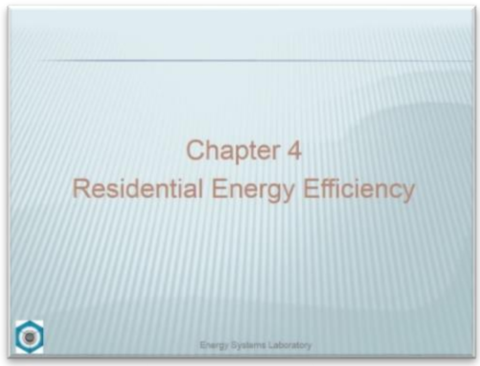
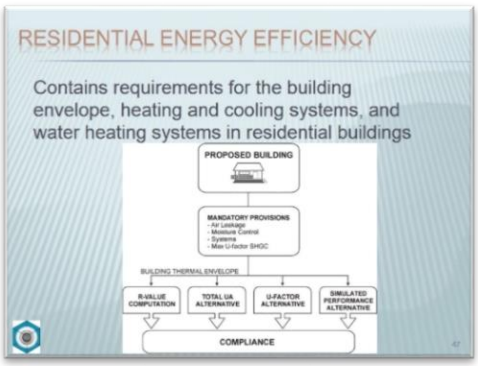


TABLE 303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC

SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
Clear	Tinted	Clear	Tinted	
0.8	0.7	0.7	0.6	0.6





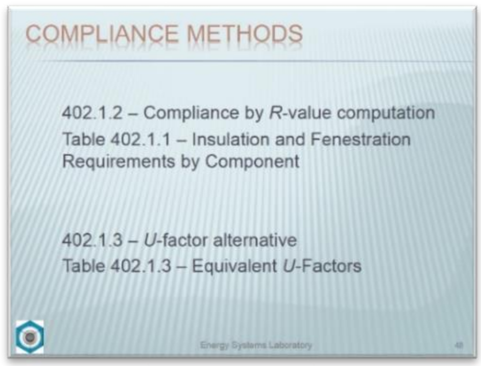


Figure 35: Presentations to BPI, February 2012 (continued)

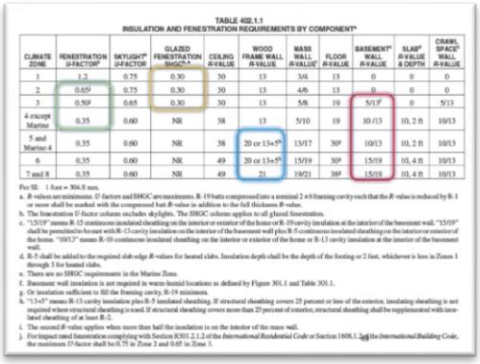


TABLE 402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION U-FACTOR[b]	SKYLIGHT[b] U-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE[i]	FLOOR R-VALUE	BASEMENT[c] WALL R-VALUE	SLAB[d] R-VALUE & DEPTH	CRAWL SPACE[c] WALL R-VALUE
1	1.2	0.75	0.30	30	13	3/4	13	0	0	0
2	0.65[j]	0.75	0.30	30	13	4/6	13	0	0	0
3	0.50[j]	0.65	0.30	30	13	5/8	19	5/13[f]	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5[h]	13/17	30[g]	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13+5[h]	15/19	30[g]	15/19	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19/21	38[g]	15/19	10, 4 ft	10/13

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. U-factors and SHGC are maximums. R-19 batts compressed into a nominal 2 × 6 framing cavity such that the R-value is reduced by R-1 or more shall be marked with the compressed batt R-value in addition to the full thickness R-value.

b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

c. "15/19" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

d. R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.

g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.

i. The second R-value applies when more than half the insulation is on the interior of the mass wall.

j. For impact rated fenestration complying with Section R301.2.1.2 of the *International Residential Code* or Section 1608.1.2 of the *International Building Code*, the maximum U-factor shall be 0.75 in Zone 2 and 0.65 in Zone 3.

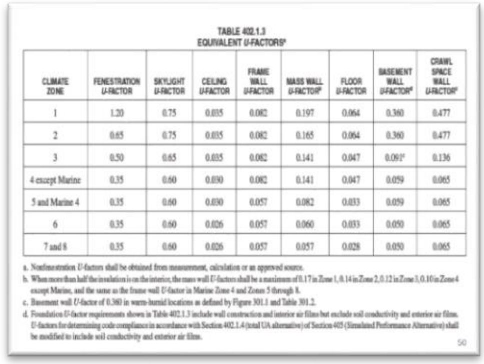


TABLE 402.1.3
EQUIVALENT U-FACTORS[a]

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR[b]	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR[d]	CRAWL SPACE WALL U-FACTOR[c]
1	1.20	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.65	0.75	0.035	0.082	0.165	0.064	0.360	0.477
3	0.50	0.65	0.035	0.082	0.141	0.047	0.091[c]	0.136
4 except Marine	0.35	0.60	0.030	0.082	0.141	0.047	0.059	0.065
5 and Marine 4	0.35	0.60	0.030	0.057	0.082	0.033	0.059	0.065
6	0.35	0.60	0.026	0.057	0.060	0.033	0.050	0.065
7 and 8	0.35	0.60	0.026	0.057	0.057	0.028	0.050	0.065

a. Nonfenestration U-factors shall be obtained from measurement, calculation or an approved source.

b. When more than half the insulation is on the interior, the mass wall U-factors shall be a maximum of 0.17 in Zone 1, 0.14 in Zone 2, 0.12 in Zone 3, 0.10 in Zone 4 except Marine, and the same as the frame wall U-factor in Marine Zone 4 and Zones 5 through 8.

c. Basement wall U-factor of 0.360 in warm-humid locations as defined by Figure 301.1 and Table 301.2.

d. Foundation U-factor requirements shown in Table 402.1.3 include wall construction and interior air films but exclude soil conductivity and exterior air films. U-factors for determining code compliance in accordance with Section 402.1.4 (total UA alternative) of Section 405 (Simulated Performance Alternative) shall be modified to include soil conductivity and exterior air films.

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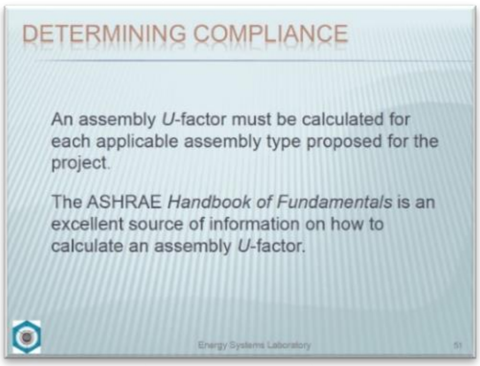
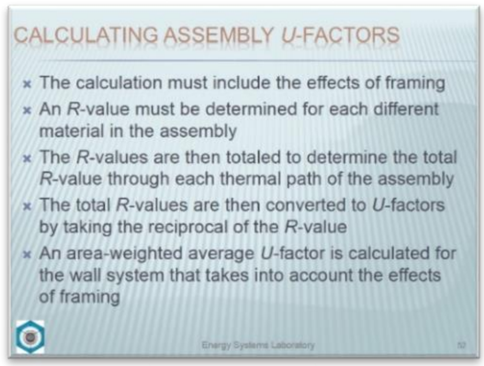
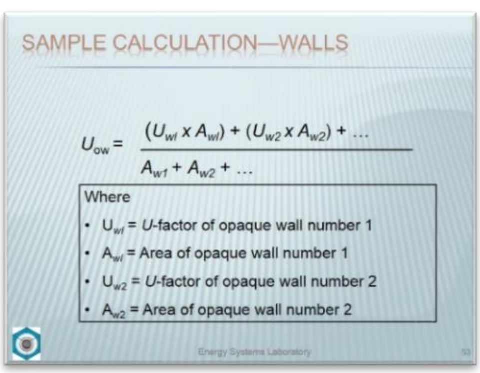






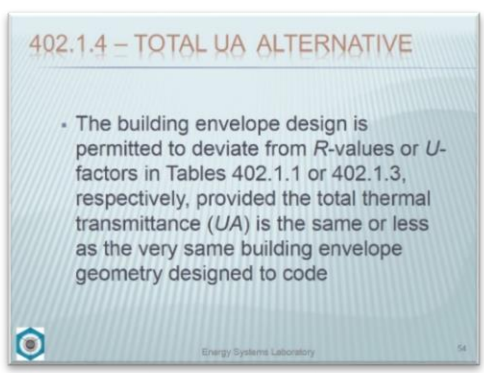
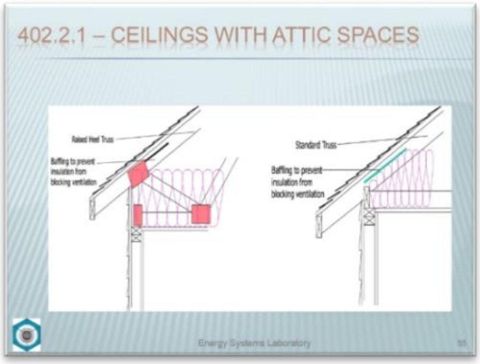
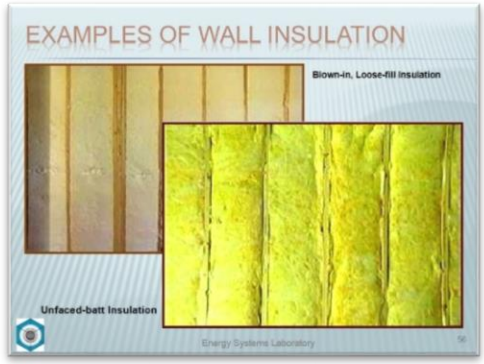
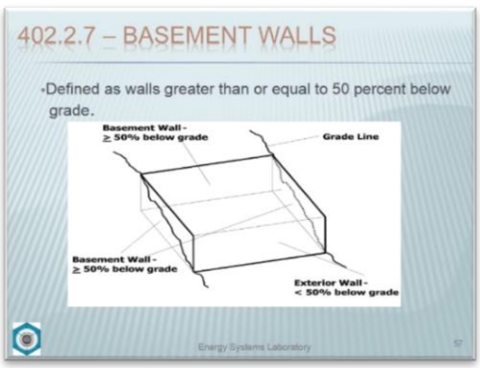
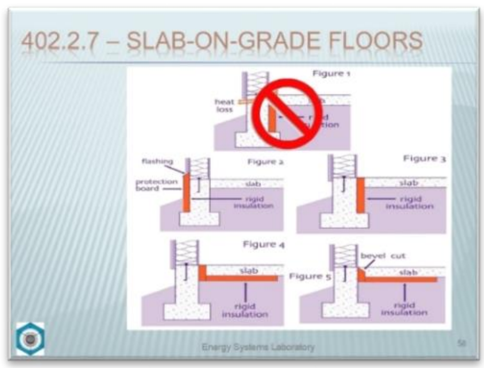


Figure 35: Presentations to BPI, February 2012 (continued)









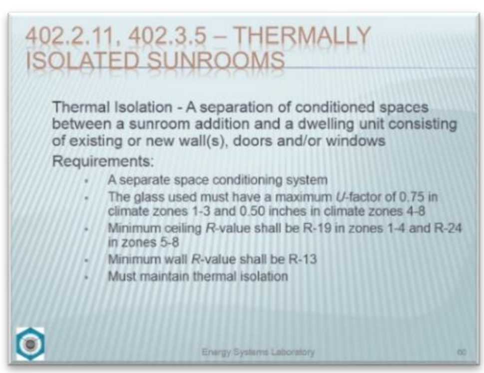
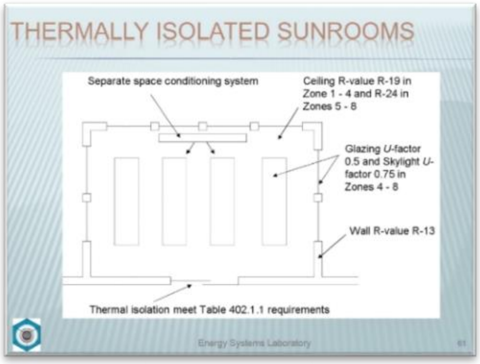
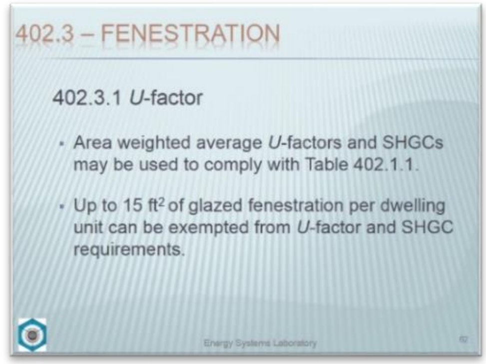
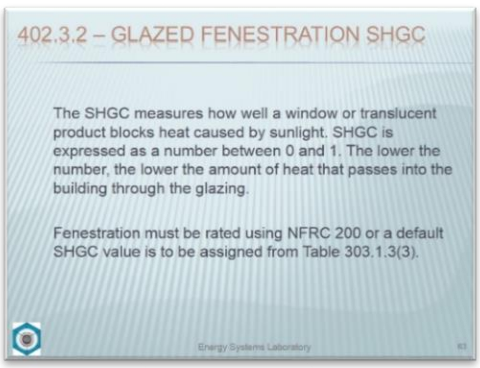
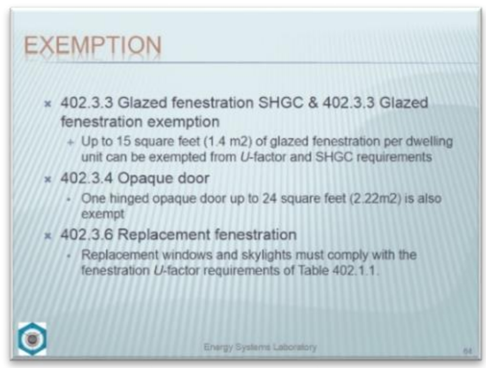


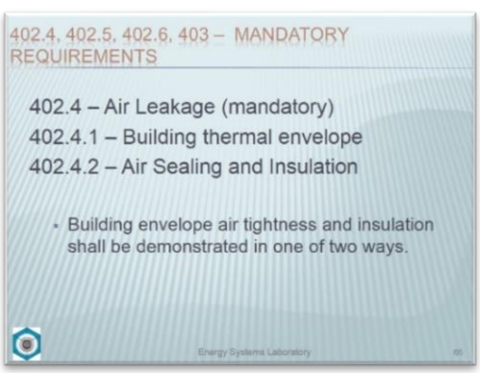
Figure 35: Presentations to BPI, February 2012 (continued)











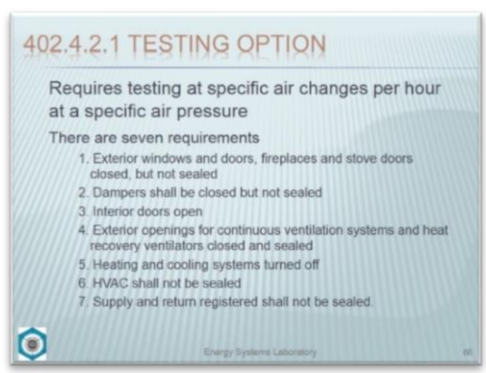
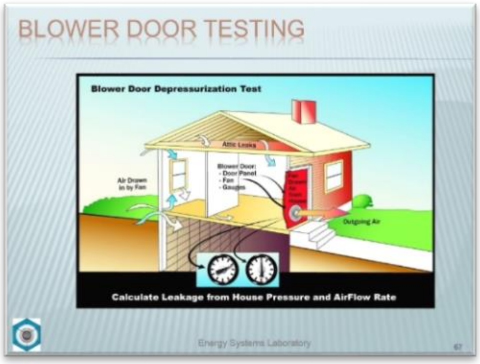
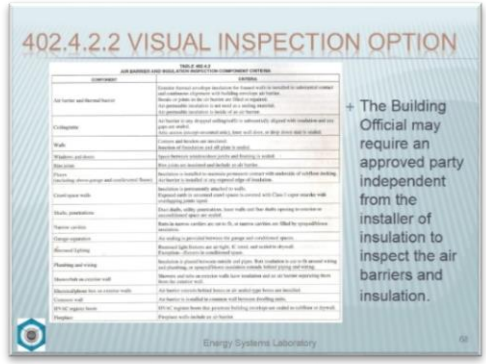
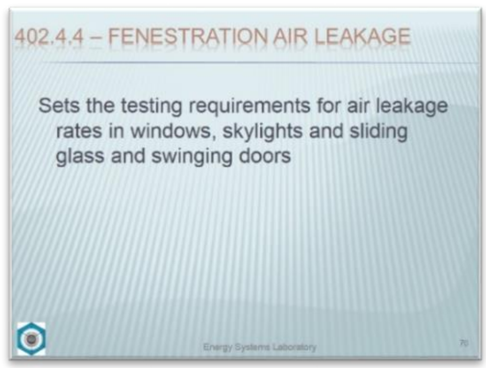


Figure 35: Presentations to BPI, February 2012 (continued)







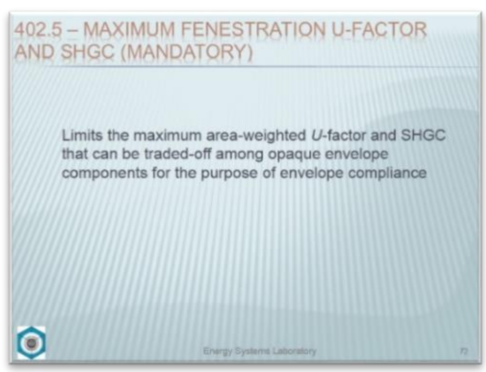
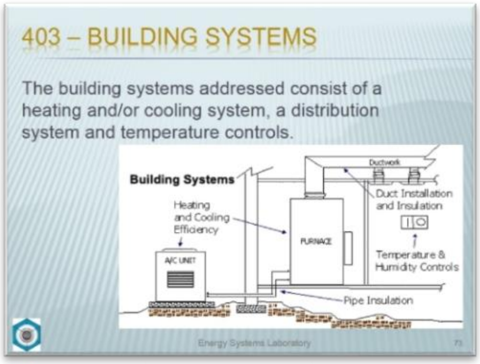
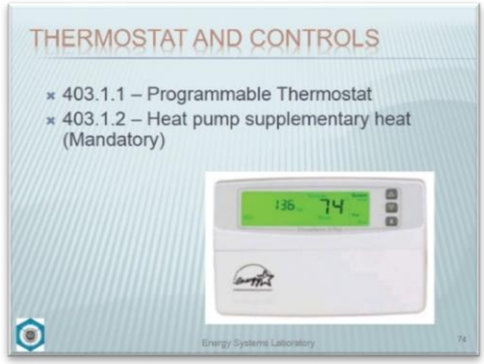
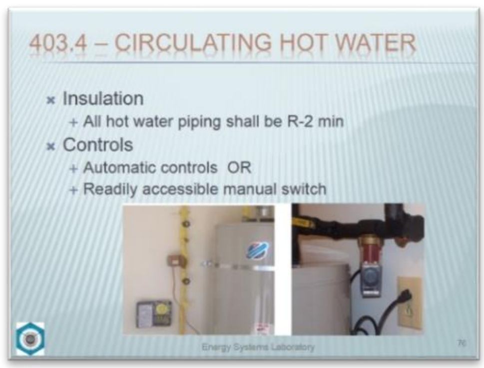


Figure 35: Presentations to BPI, February 2012 (continued)







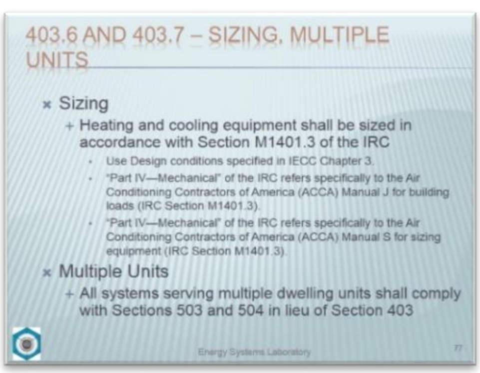
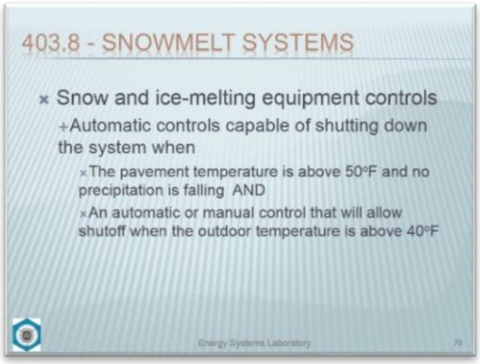
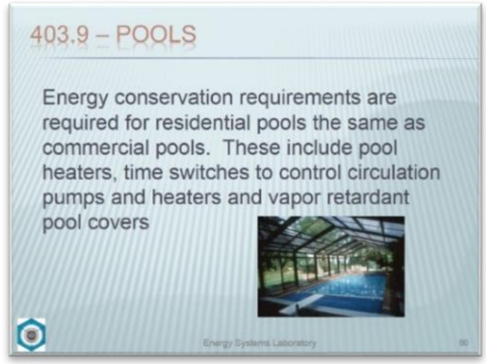


Figure 35: Presentations to BPI, February 2012 (continued)





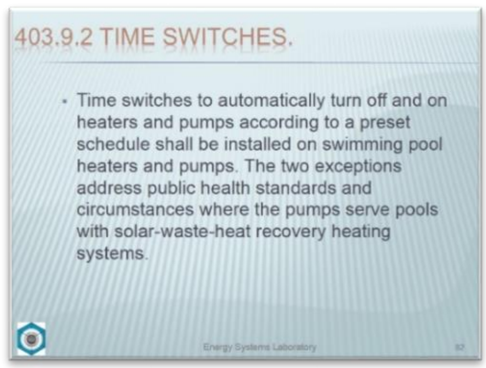
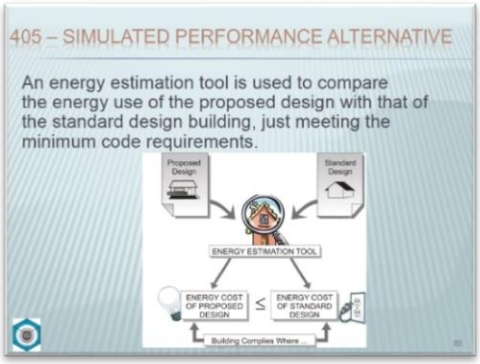
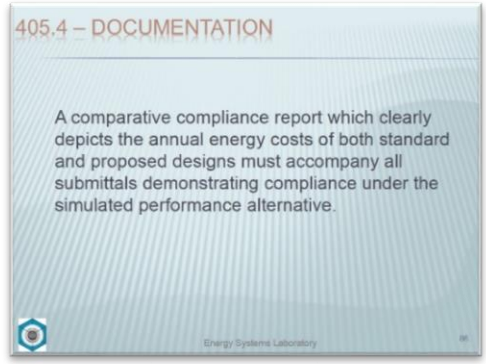
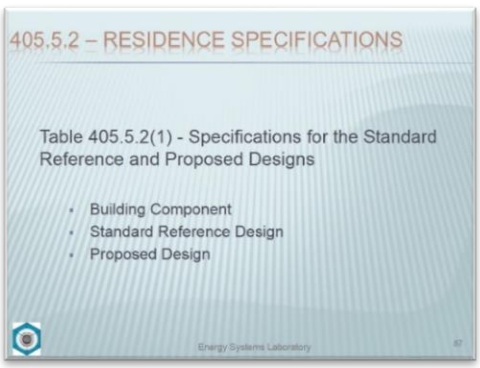


Figure 35: Presentations to BPI, February 2012 (continued)







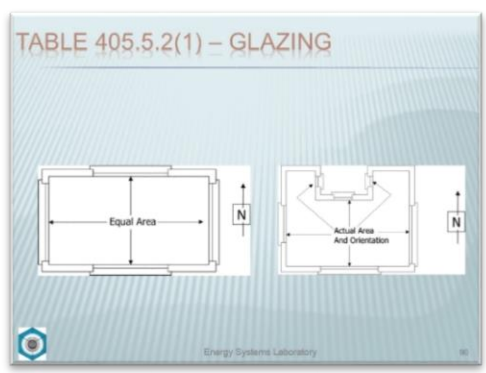
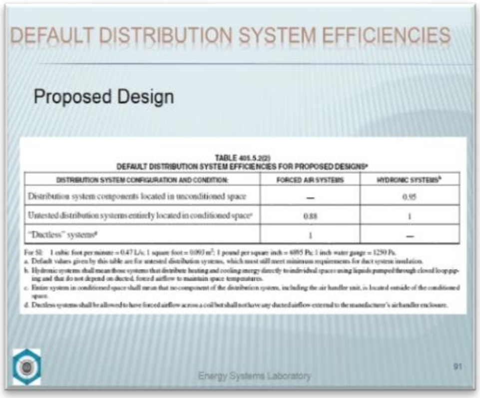


Figure 35: Presentations to BPI, February 2012 (continued)



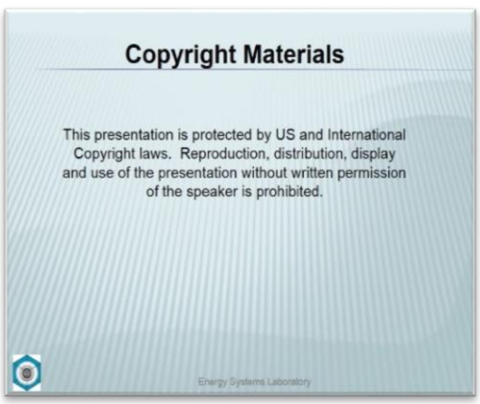
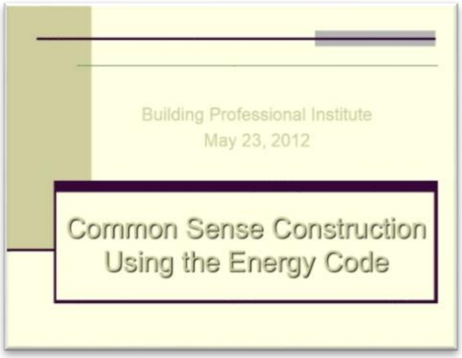
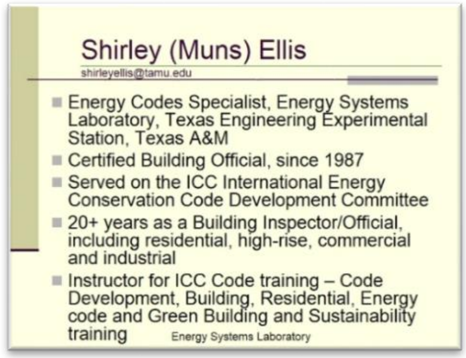
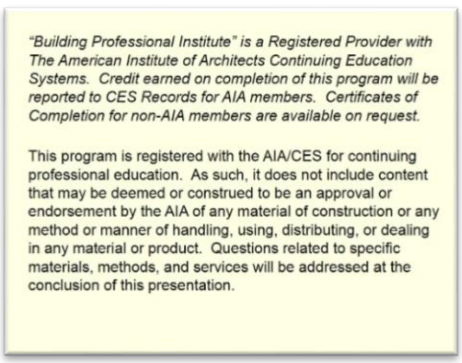


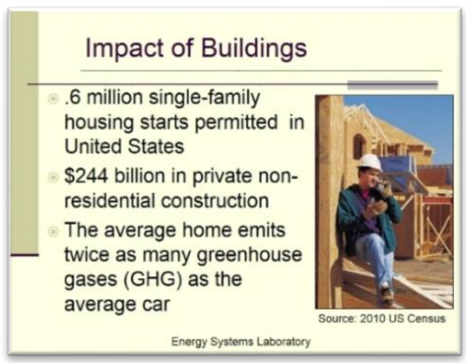
Figure 35: Presentations to BPI, February 2012 (continued)

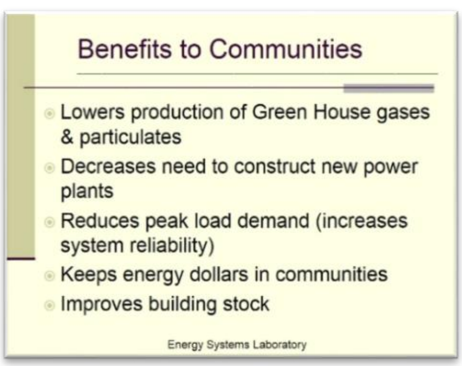
Presentation to the BPI, May 2012











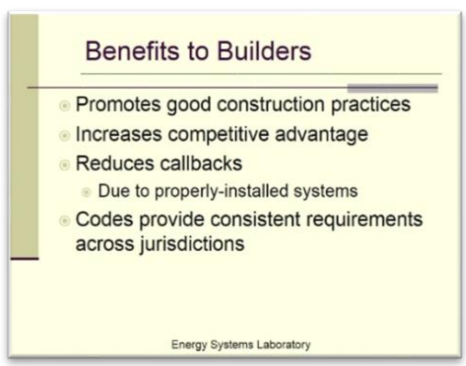
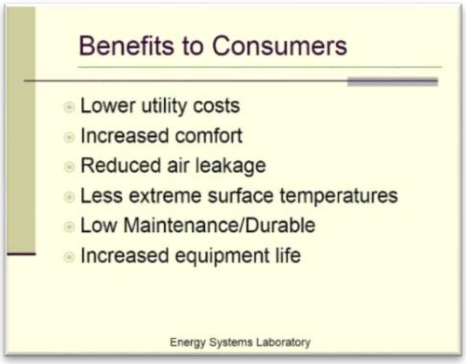
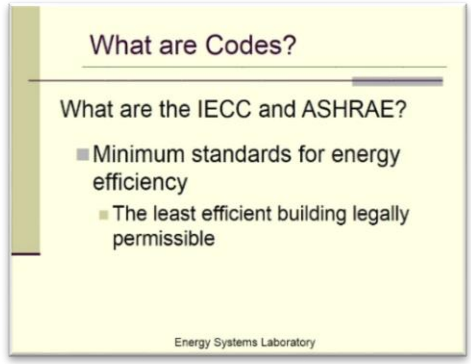
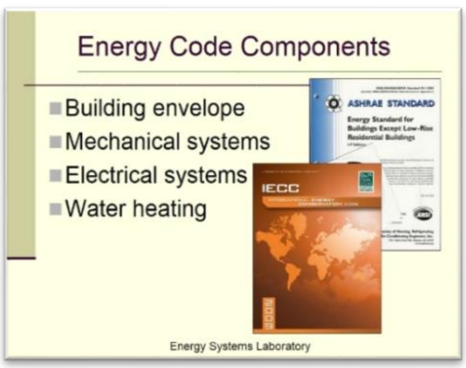


Figure 36: Presentation to BPI, May 2012







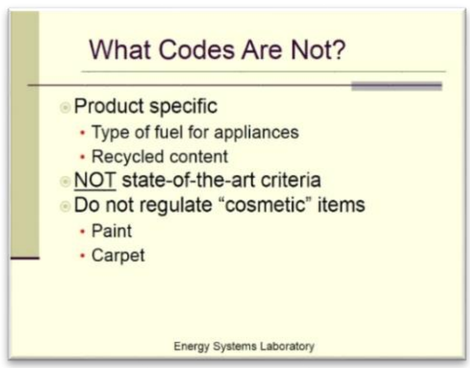
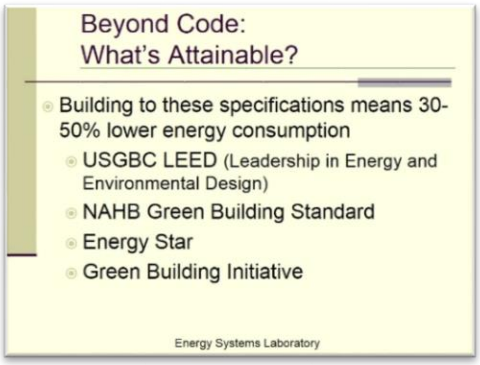
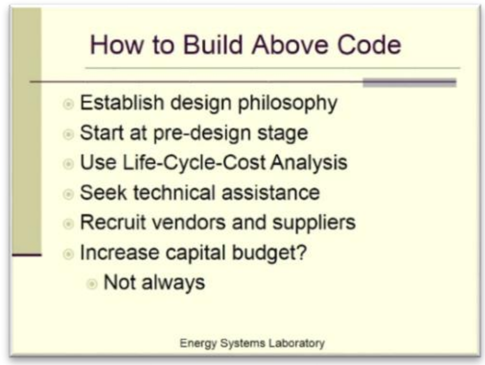
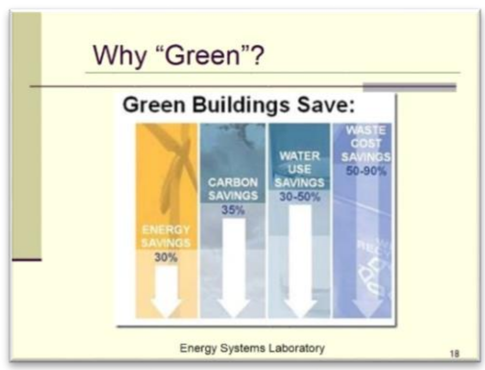
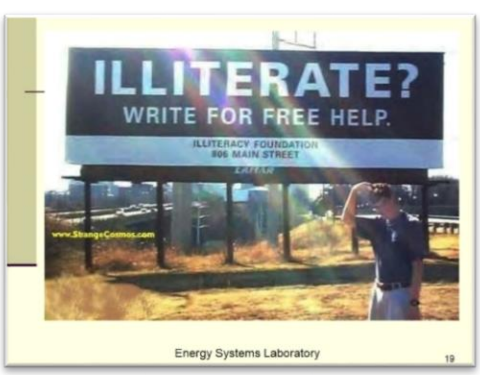


Figure 36: Presentation to BPI, May 2012 (Continued)









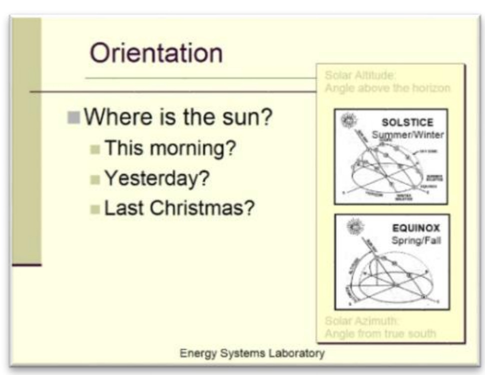
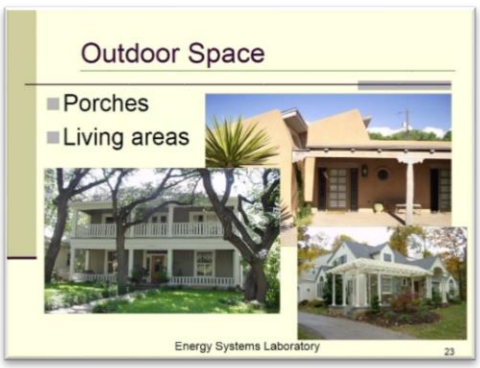
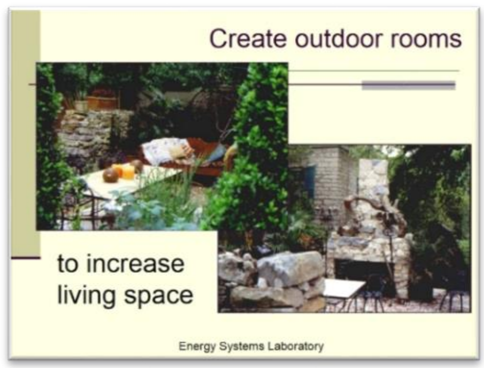


Figure 36: Presentation to BPI, May 2012 (Continued)





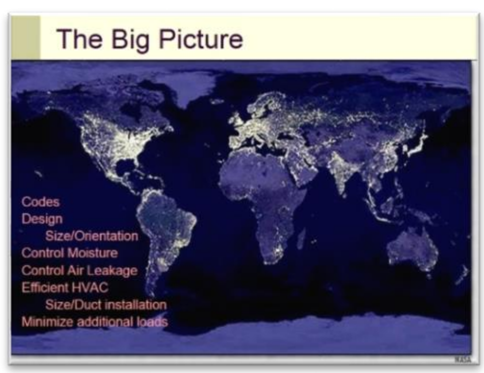
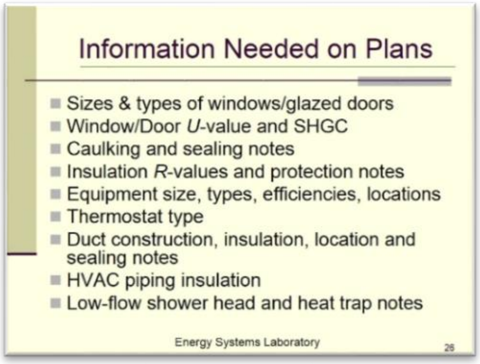
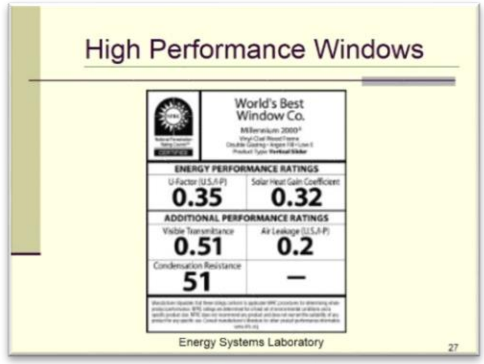
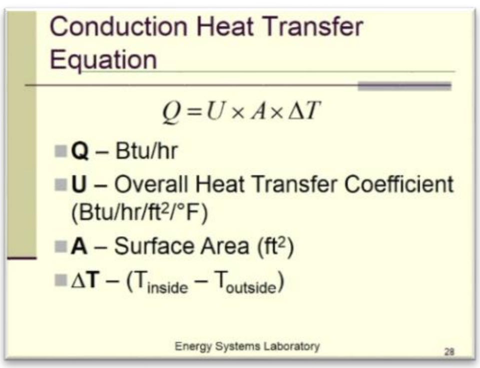
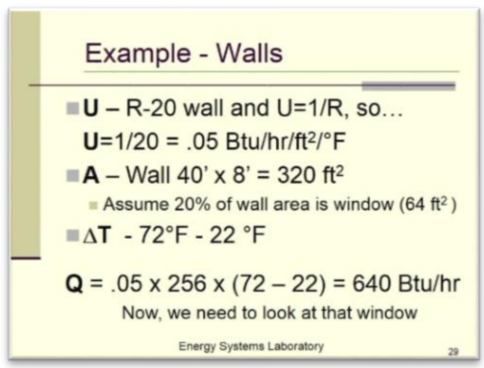


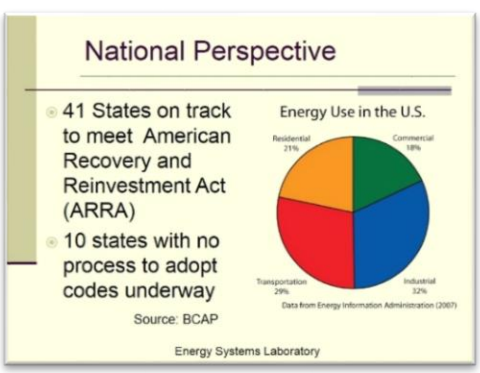
Figure 36: Presentation to BPI, May 2012 (Continued)











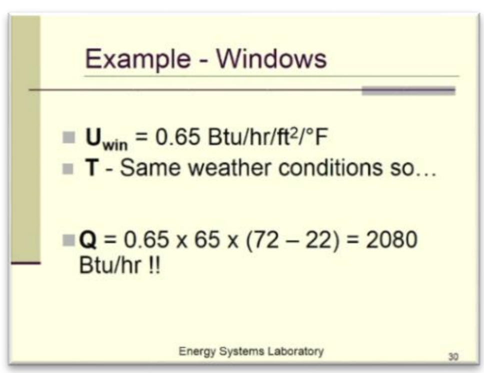
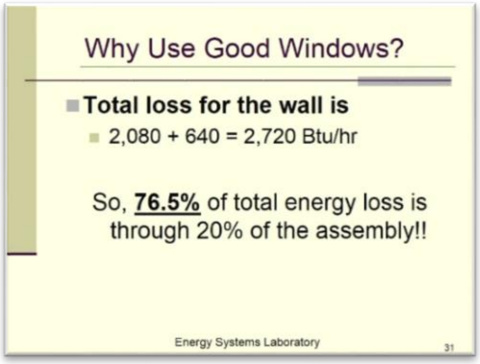
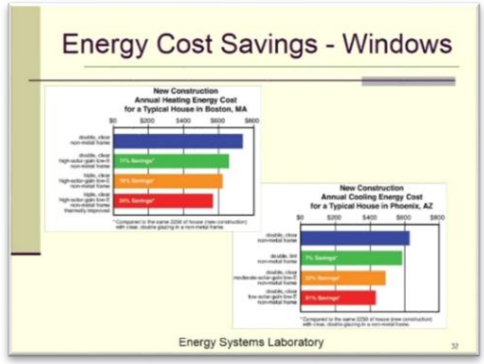
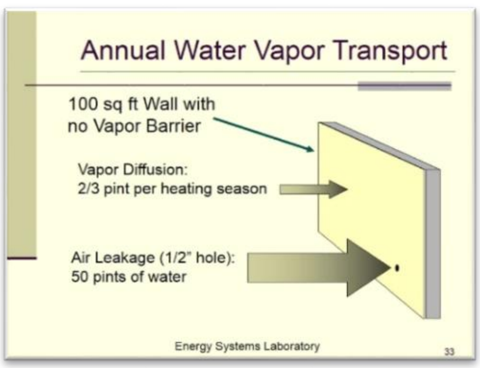
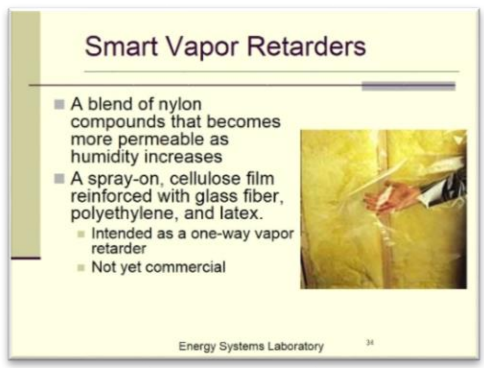


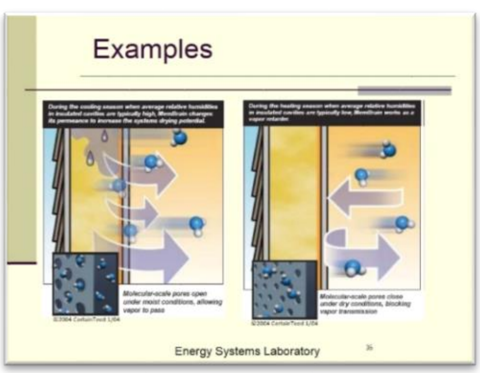
Figure 36: Presentation to BPI, May 2012 (Continued)











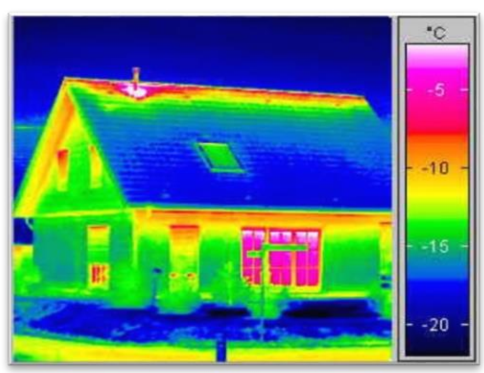
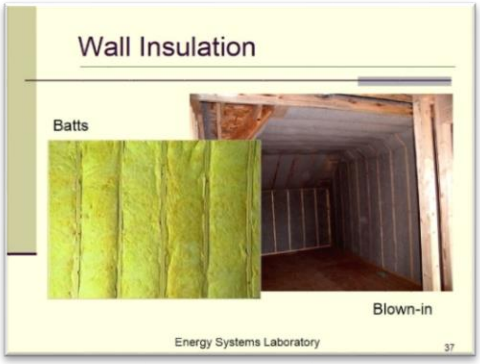
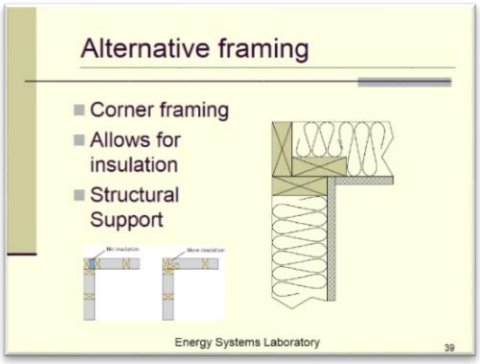


Figure 36: Presentation to BPI, May 2012 (Continued)





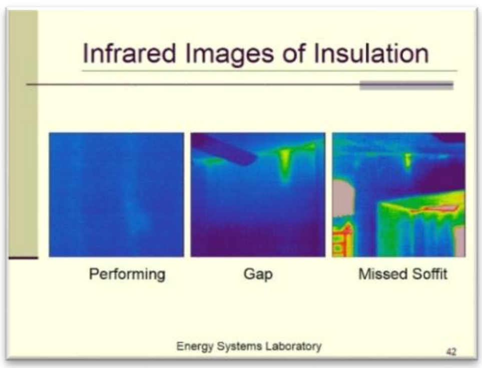
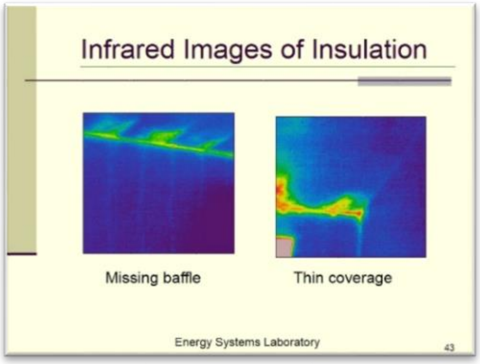
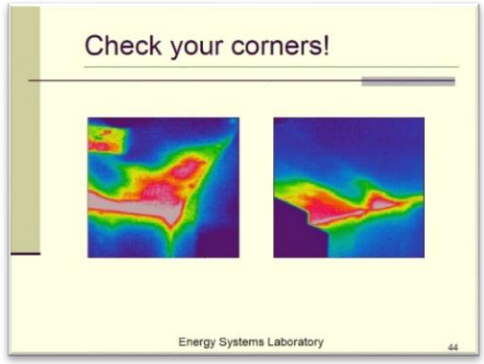
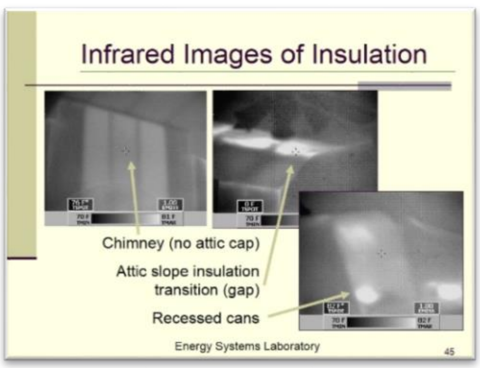


Figure 36: Presentation to BPI, May 2012 (Continued)







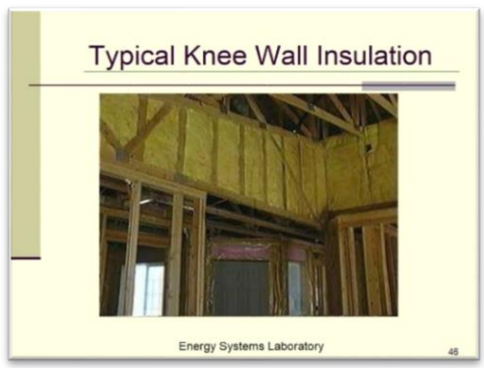
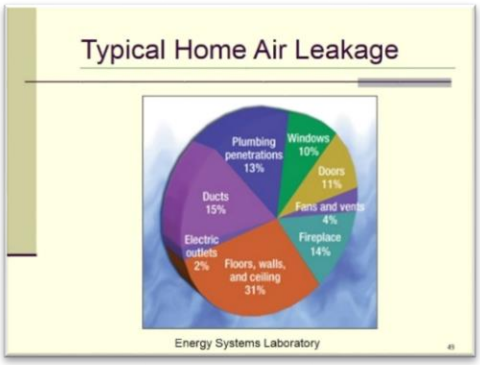
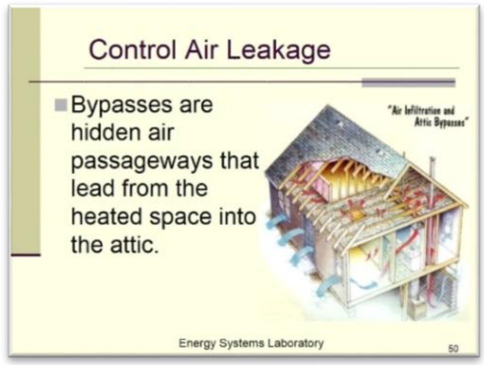


Figure 36: Presentation to BPI, May 2012 (Continued)





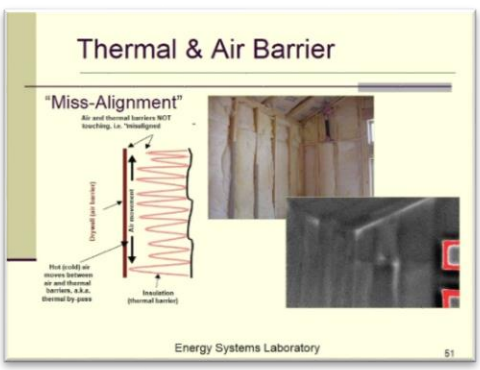
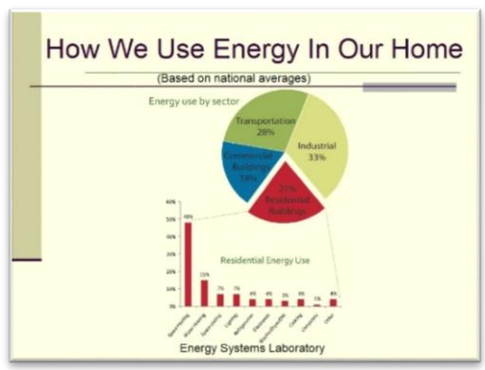
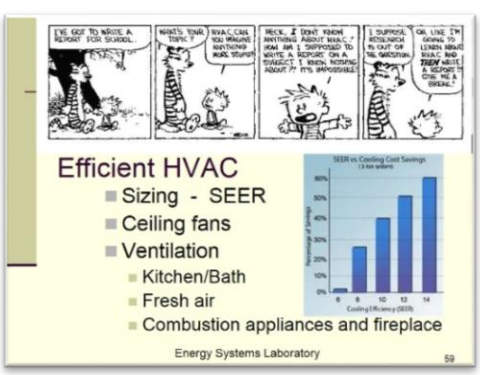


Figure 36: Presentation to BPI, May 2012 (Continued)





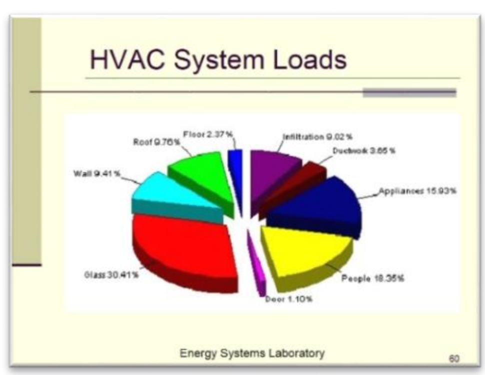
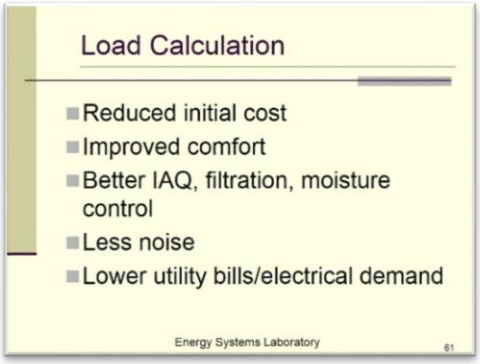
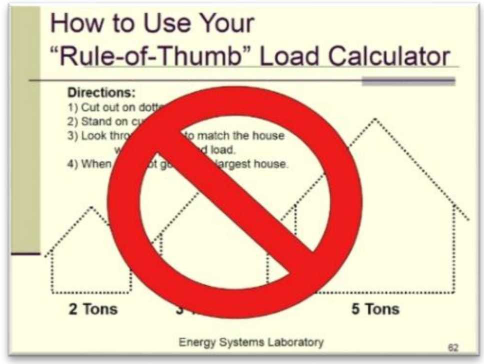
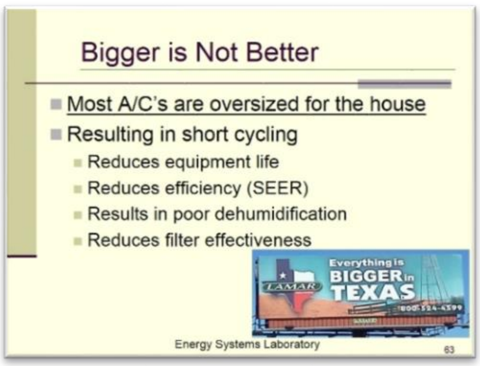
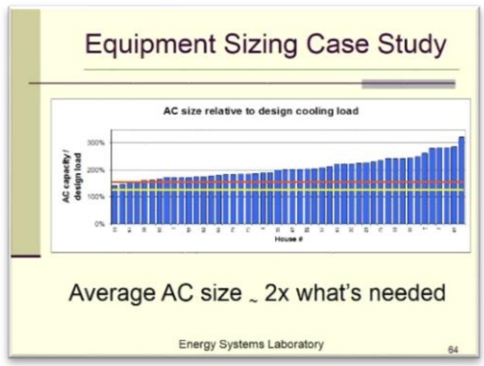


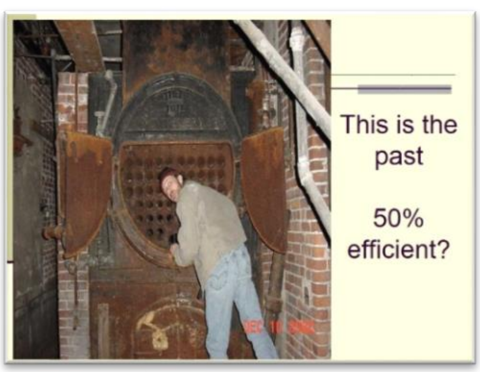
Figure 36: Presentation to BPI, May 2012 (Continued)











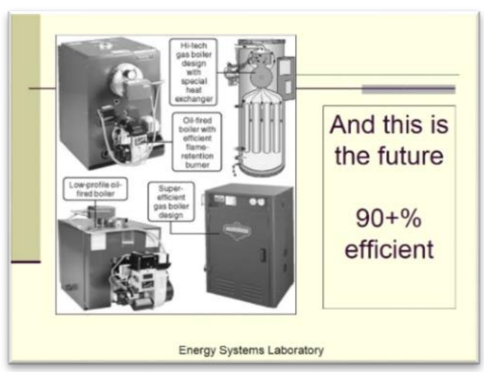
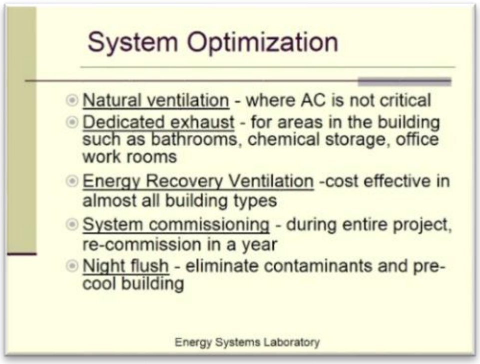
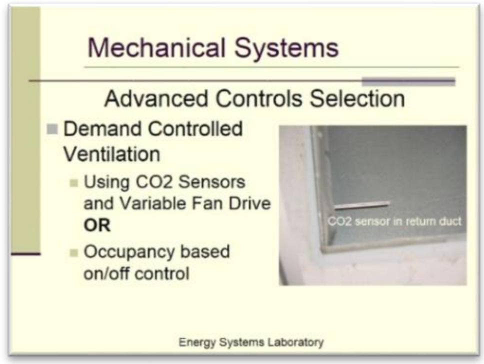
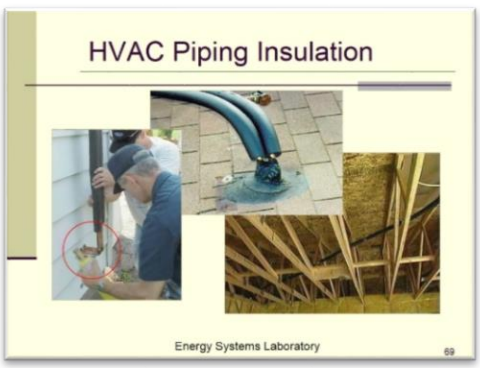
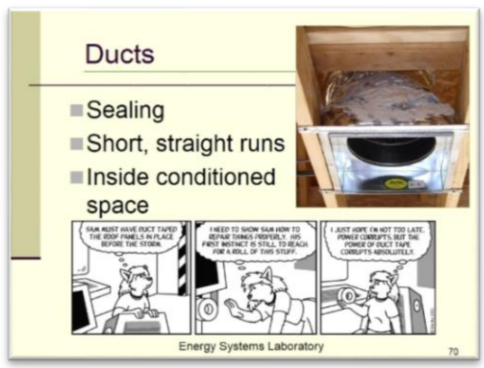


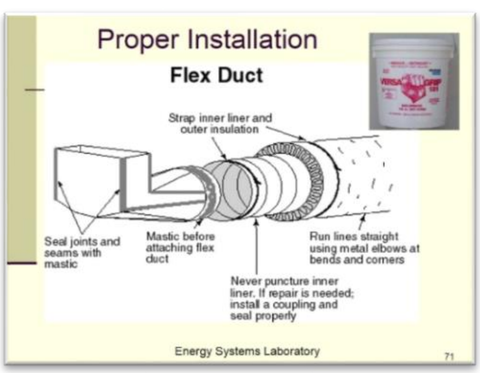
Figure 36: Presentation to BPI, May 2012 (Continued)











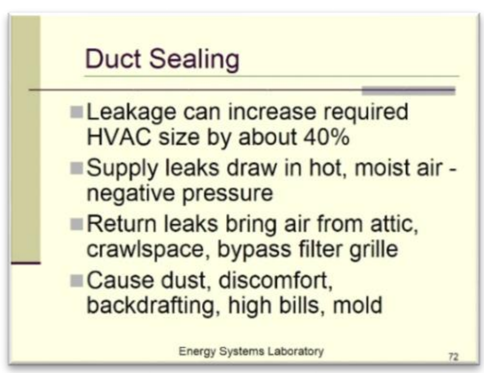
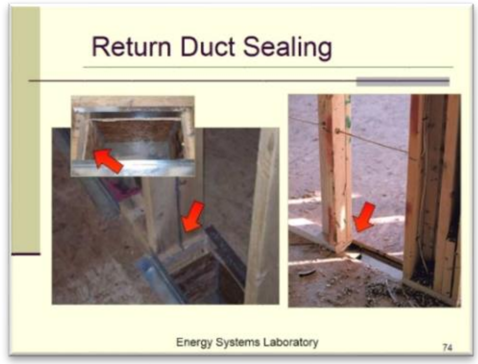
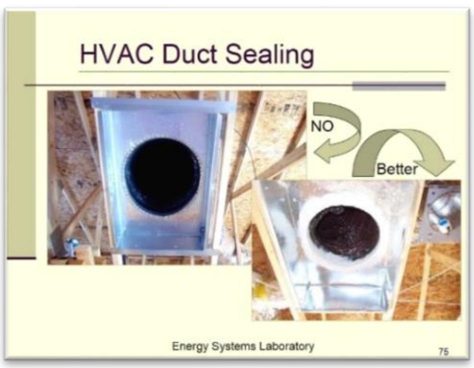
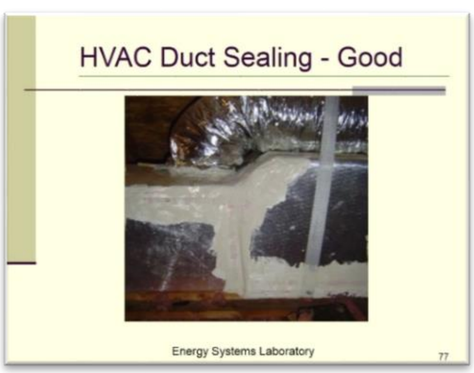


Figure 36: Presentation to BPI, May 2012 (Continued)







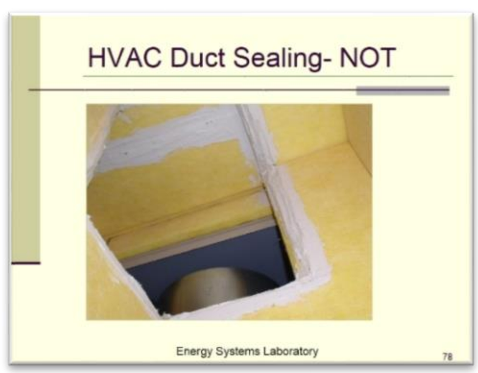
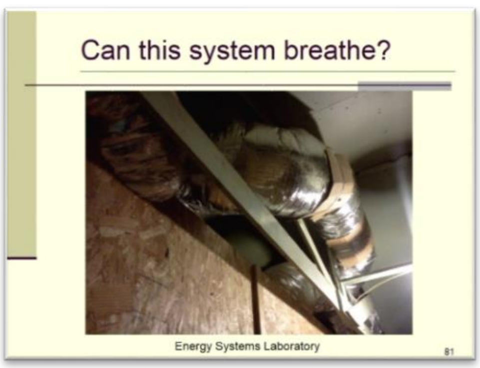


Figure 36: Presentation to BPI, May 2012 (Continued)



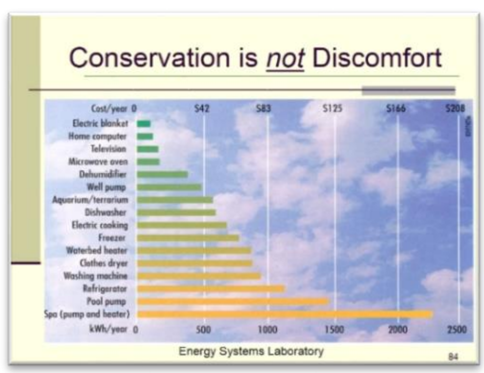
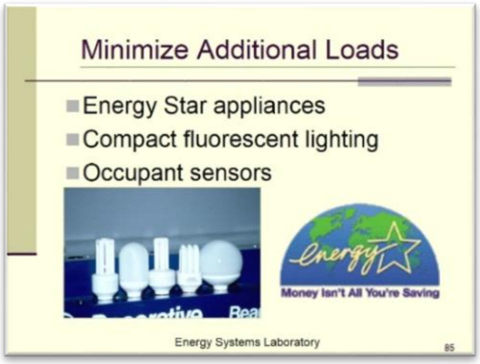
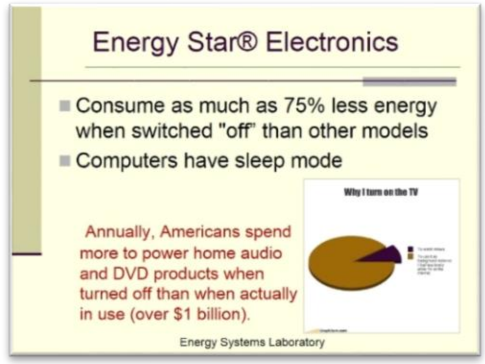
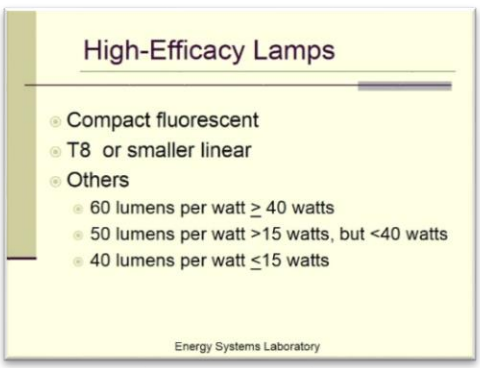
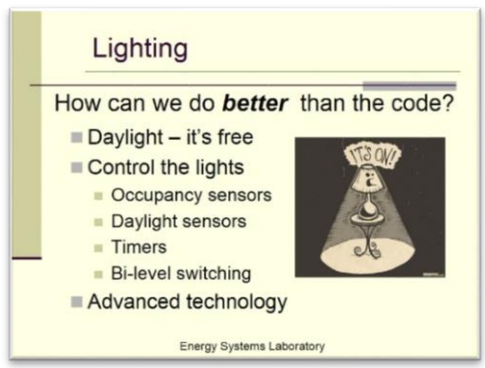


Figure 36: Presentation to BPI, May 2012 (Continued)









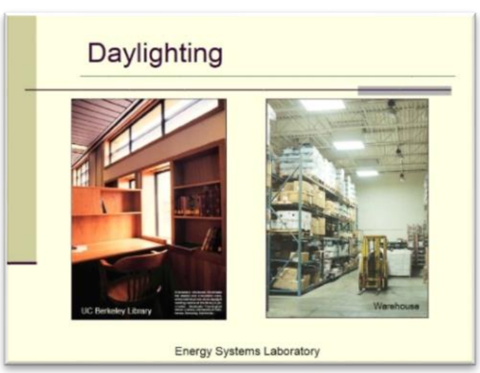
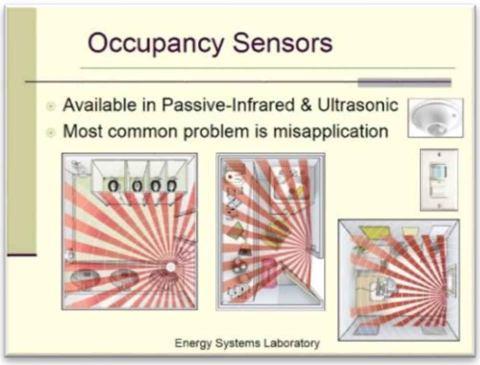
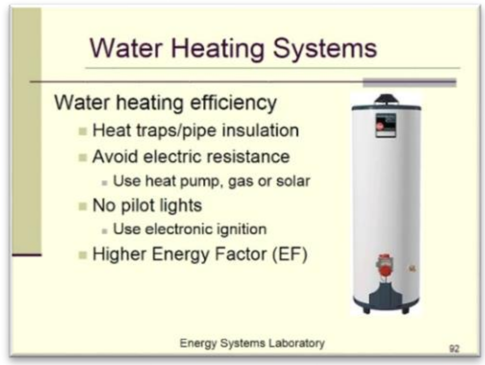
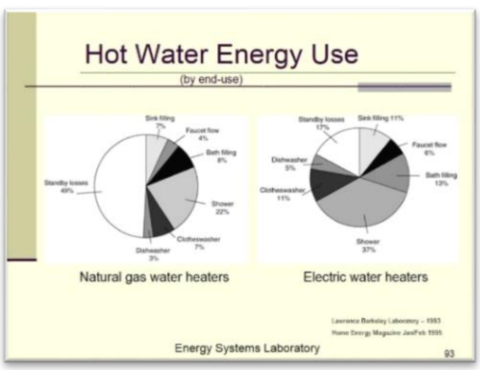
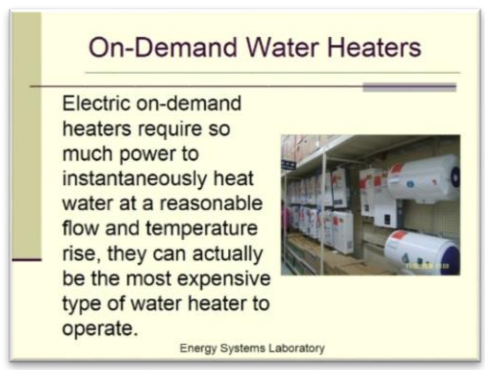


Figure 36: Presentation to BPI, May 2012 (Continued)









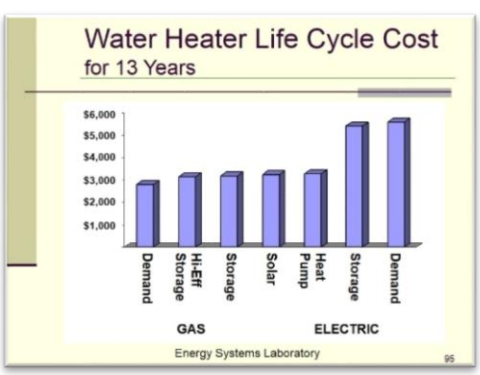
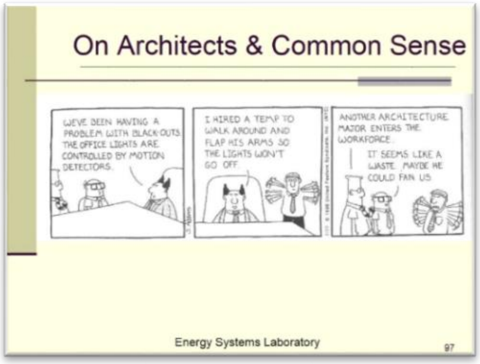
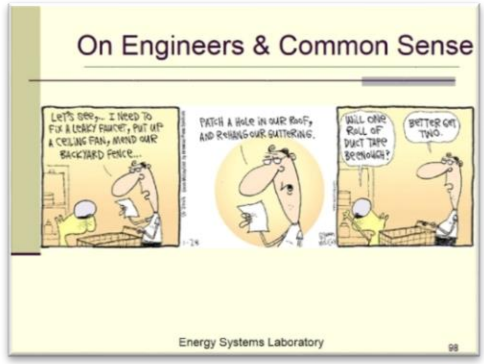
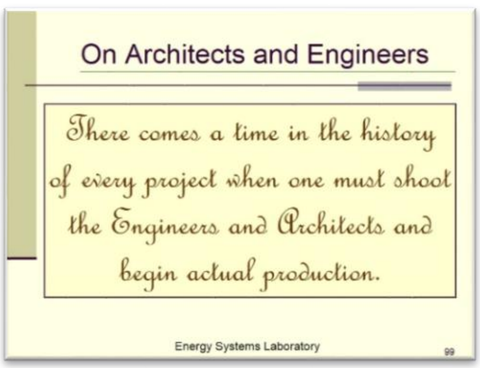
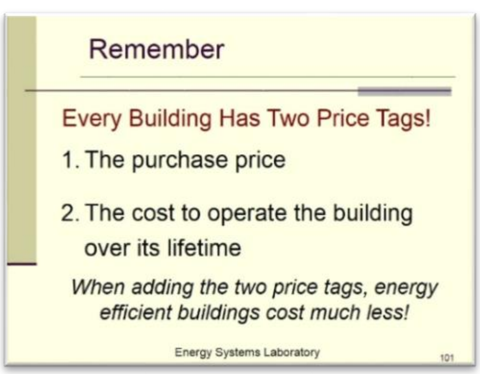


Figure 36: Presentation to BPI, May 2012 (Continued)









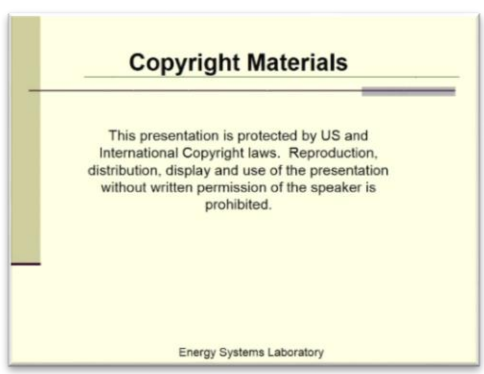
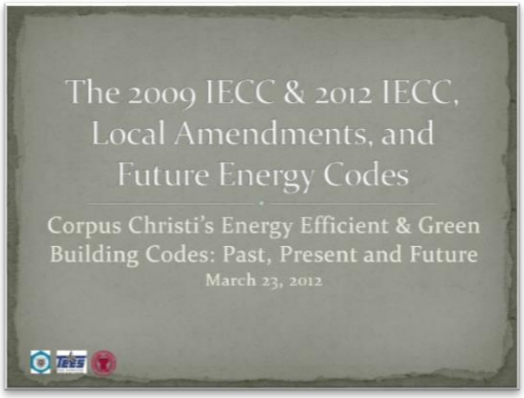
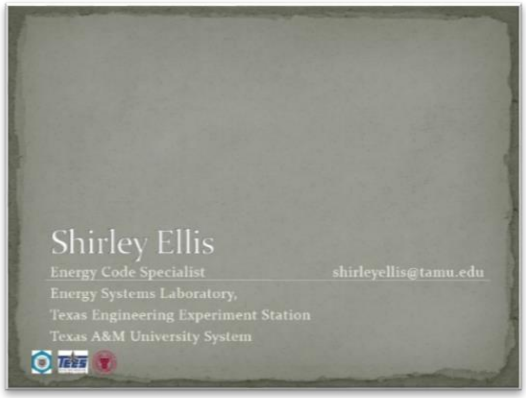
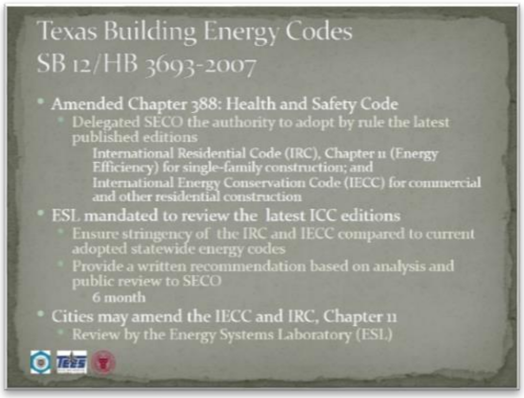


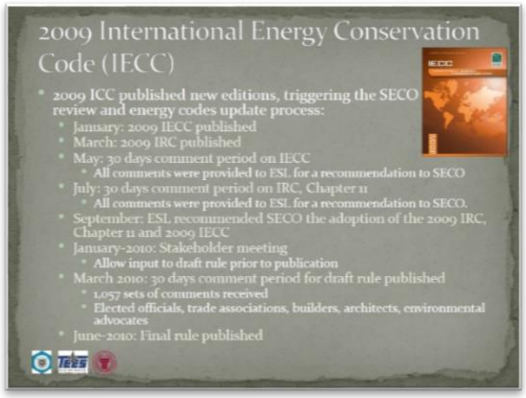
Figure 36: Presentation to BPI, May 2012 (Continued)

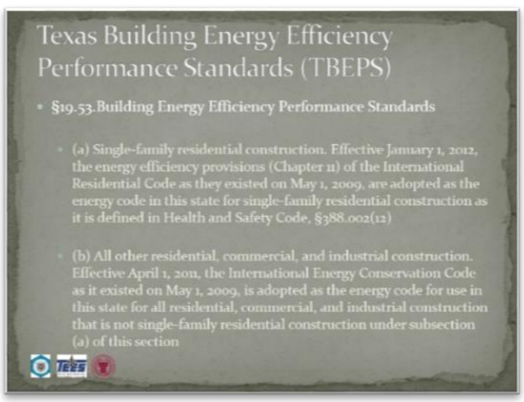
Presentation to the City of Corpus Christi, March 2012











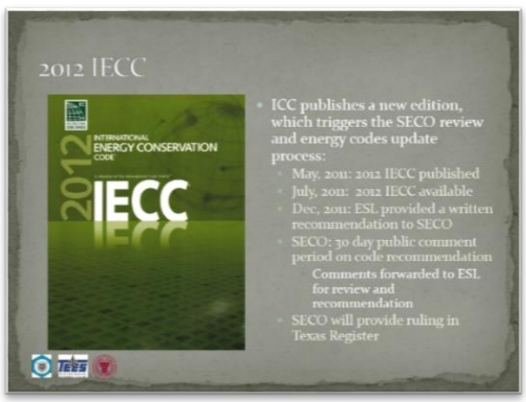
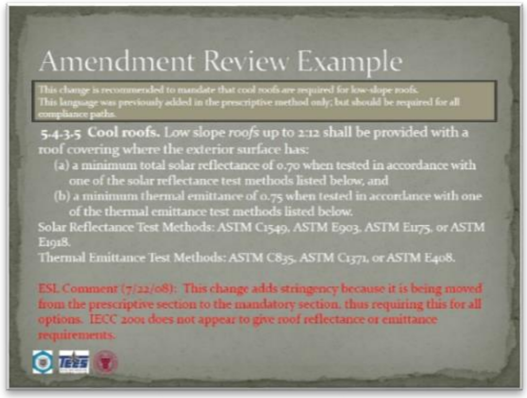


Figure 37: Presentation to the City of Corpus Christi, March 2012



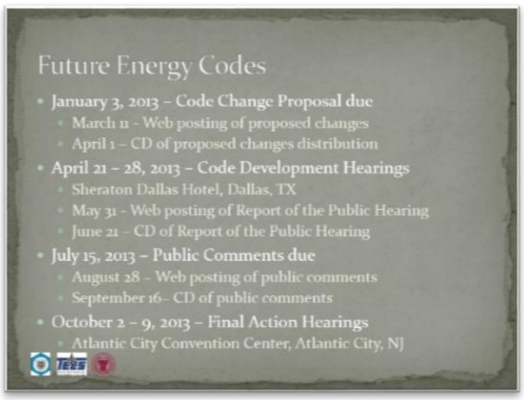
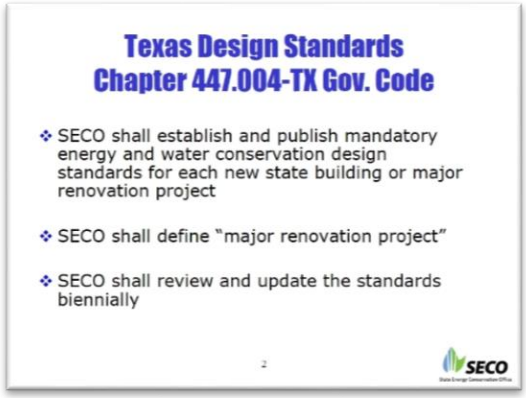
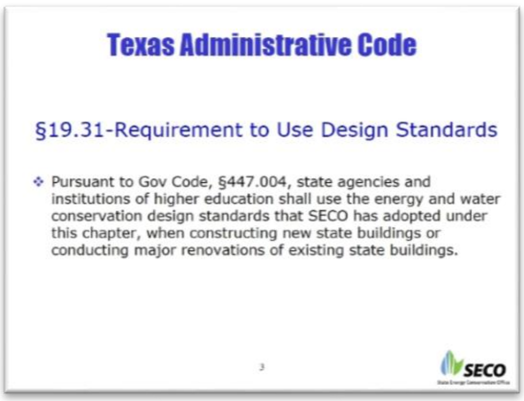
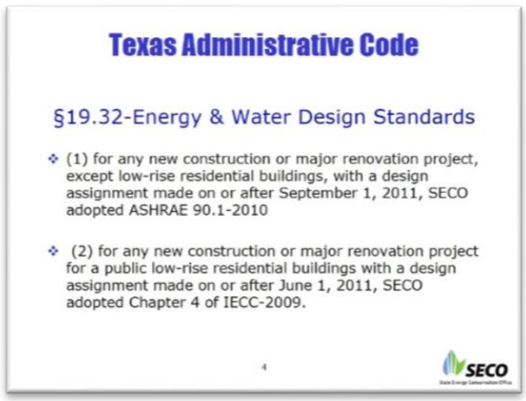


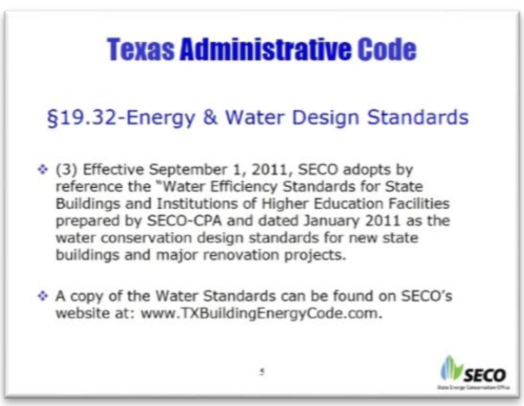
Figure 37: Presentation to the City of Corpus Christi, March 2012 (continued)

Presentation to the Sierra Club, June 2012









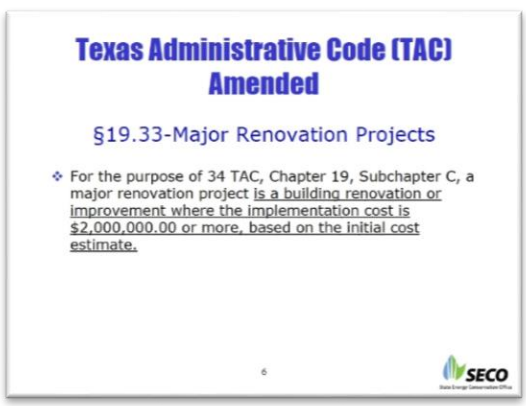
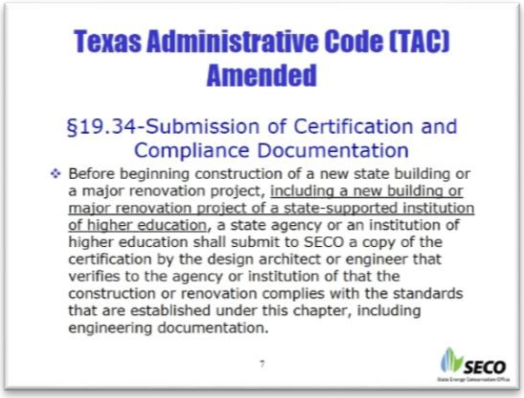
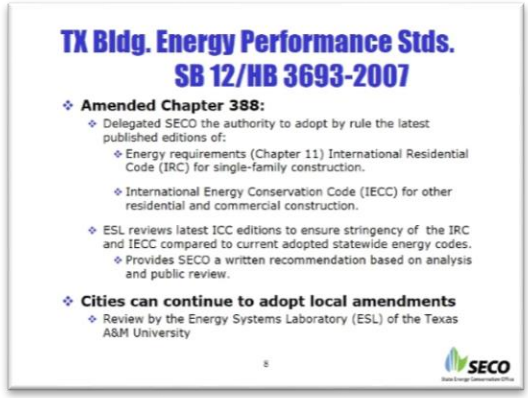
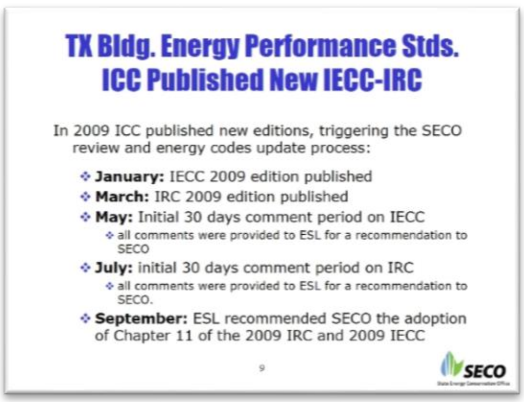
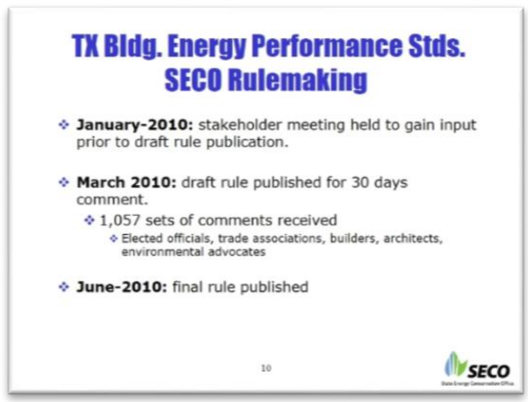


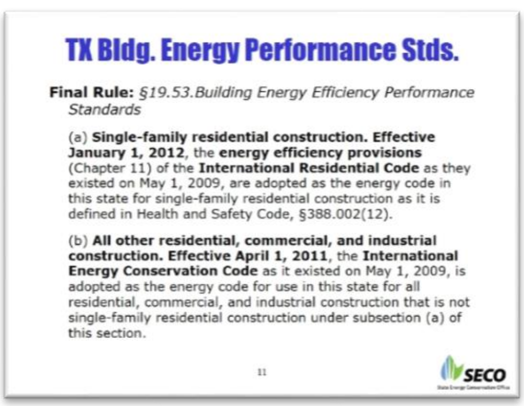
Figure 38: Presentation to the Sierra Club











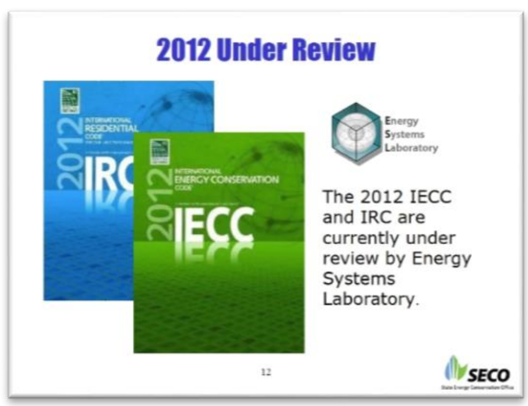
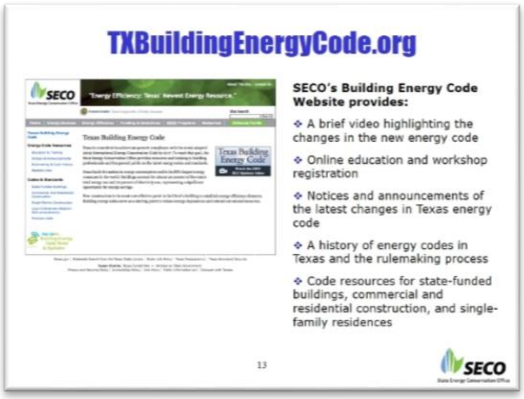


Figure 38: Presentation to the Sierra Club (Continued)



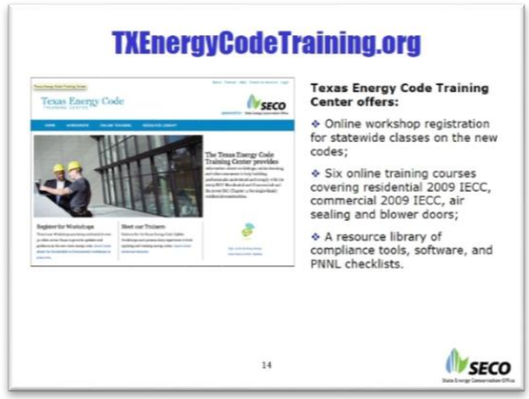
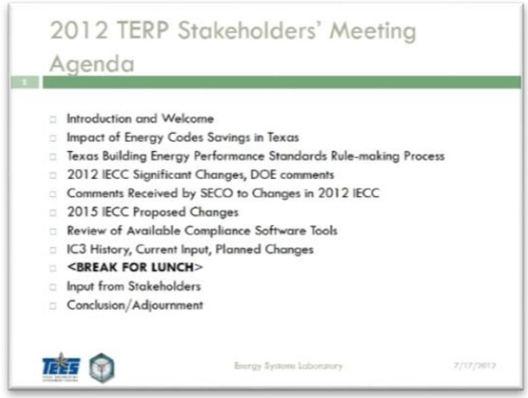
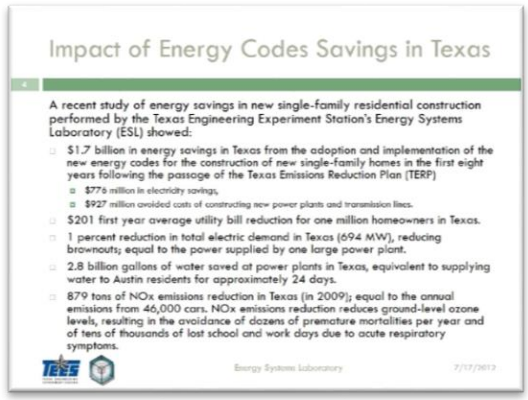


Figure 38: Presentation to the Sierra Club (Continued)

Presentation –TERP Stakeholder's Meeting, July 2012





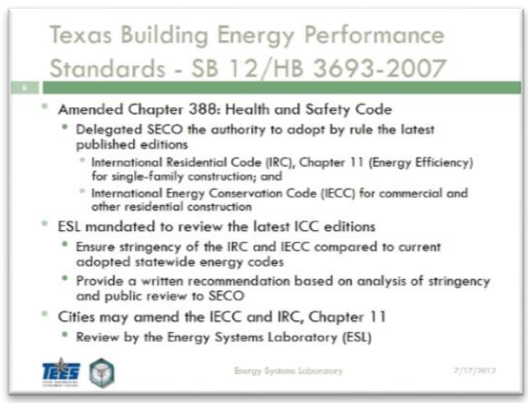
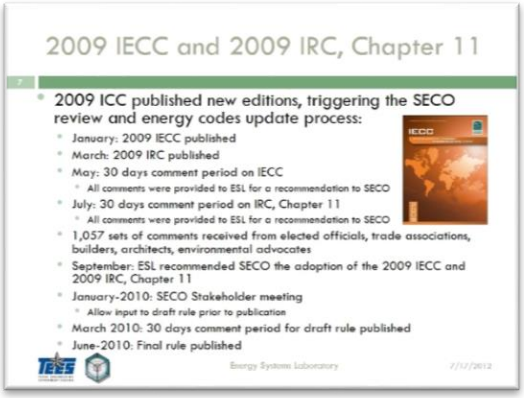
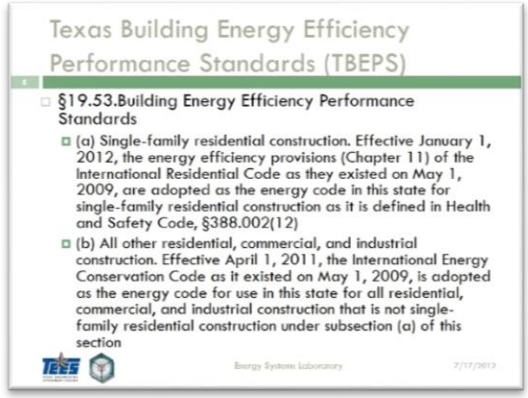
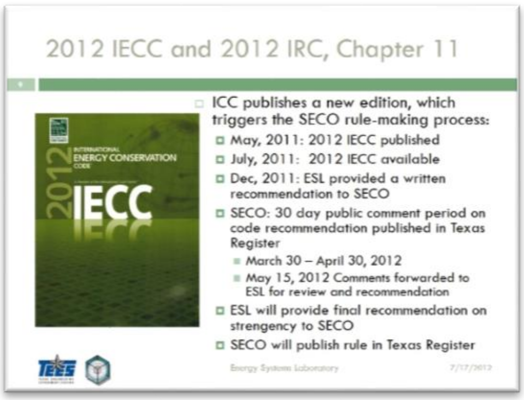
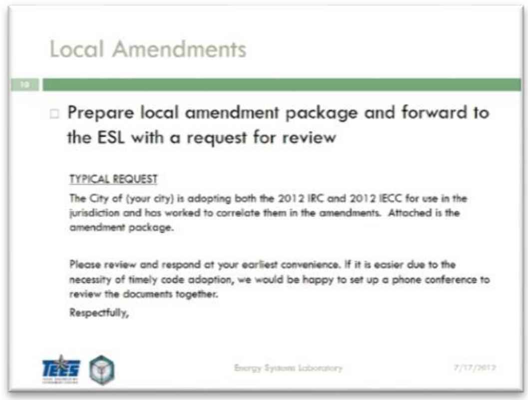


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)









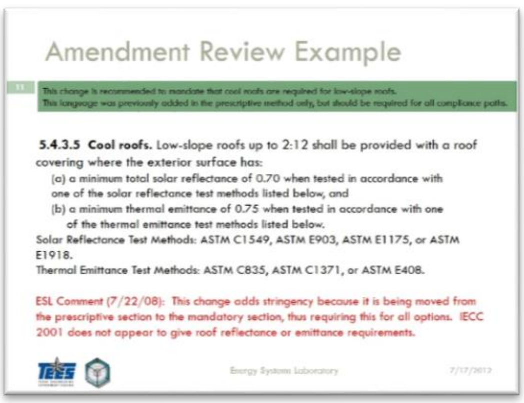
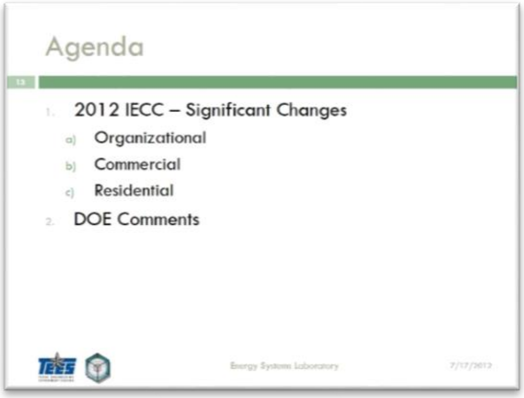
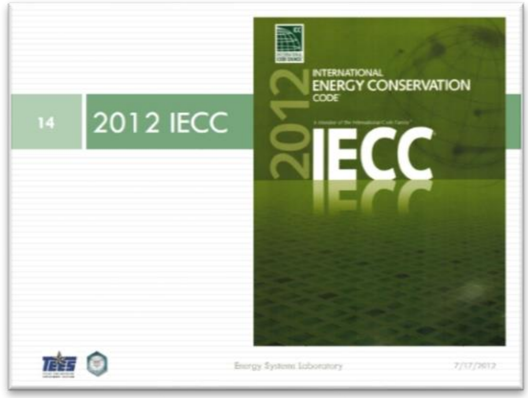
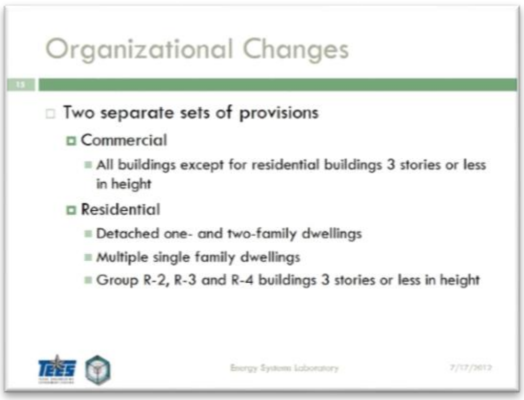
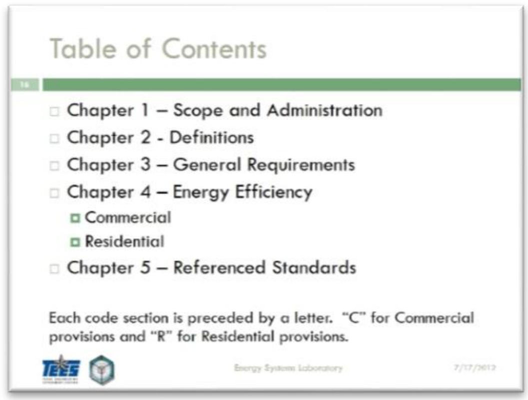


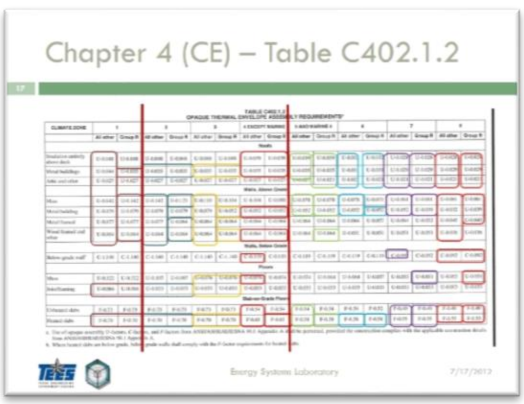
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)











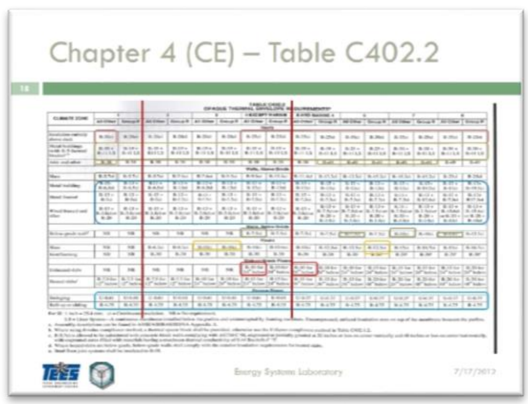
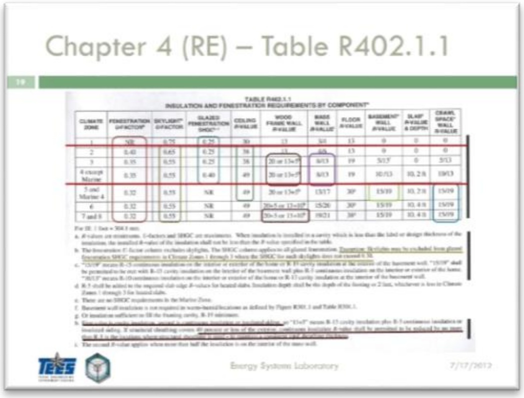
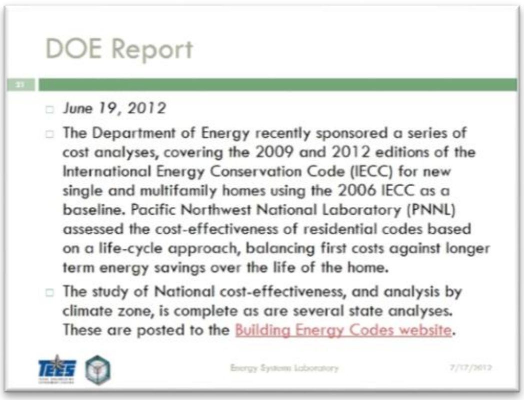
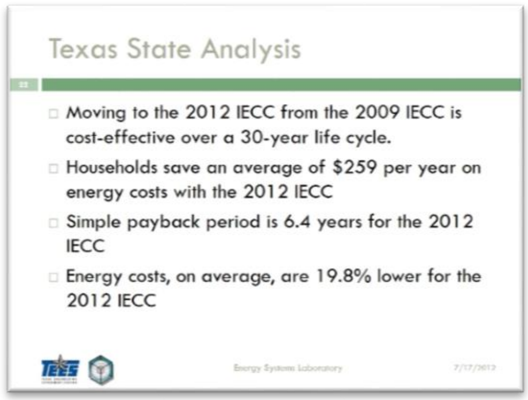


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)







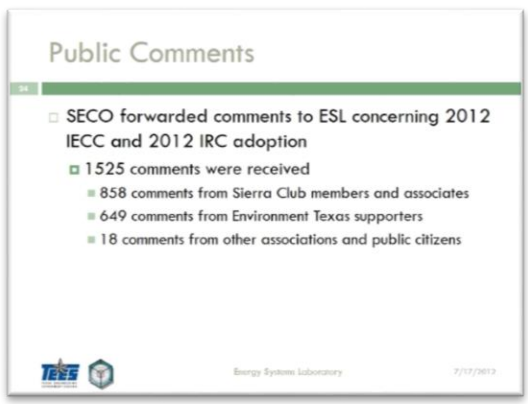
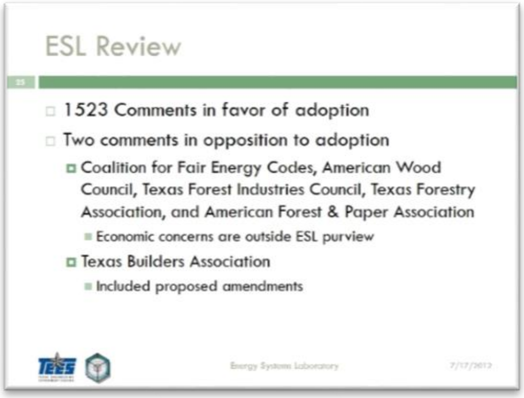
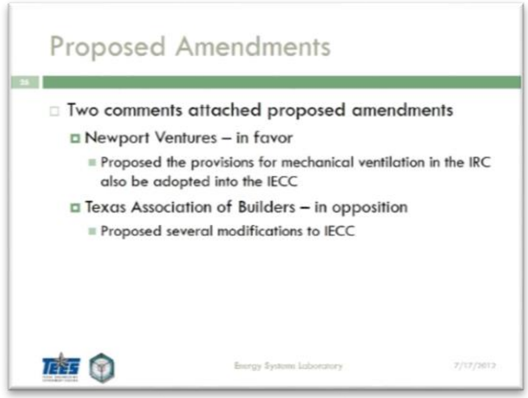
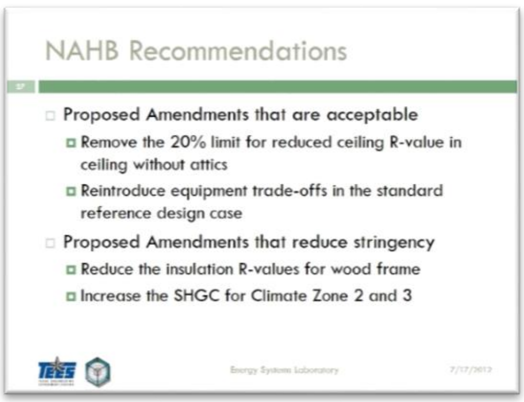


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)







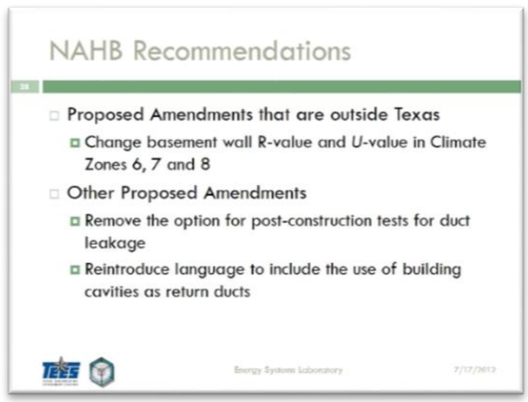
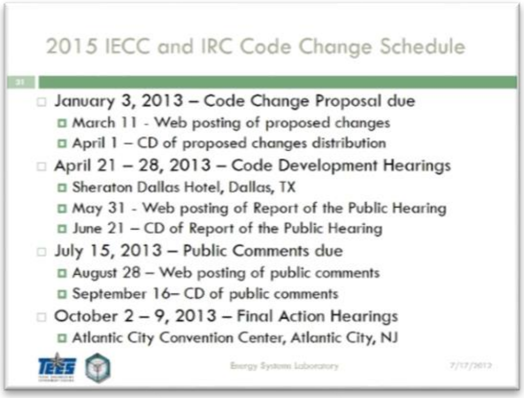
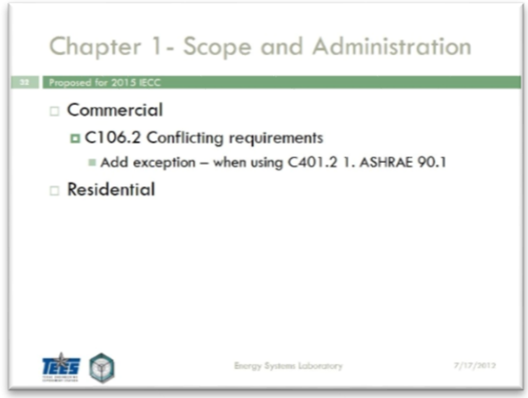
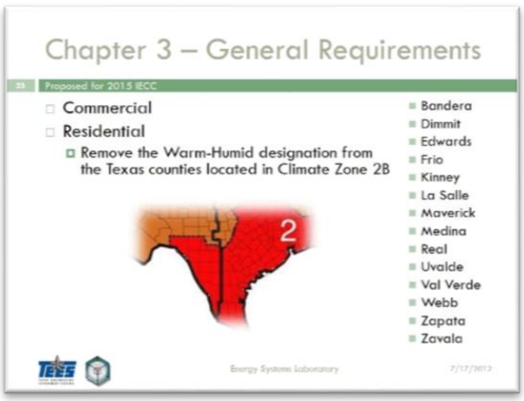
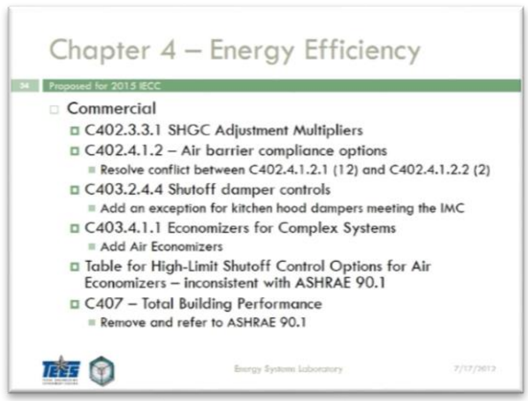


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)









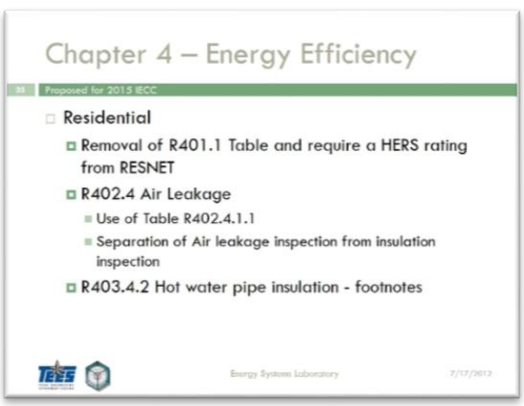
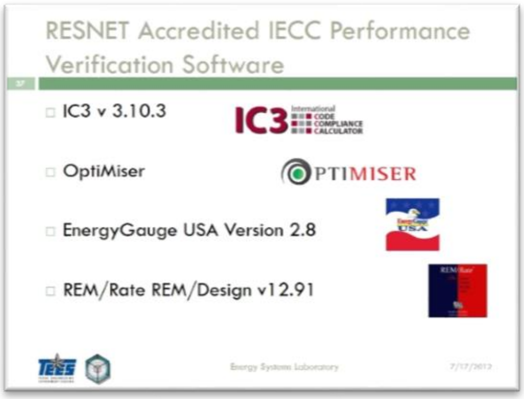


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)



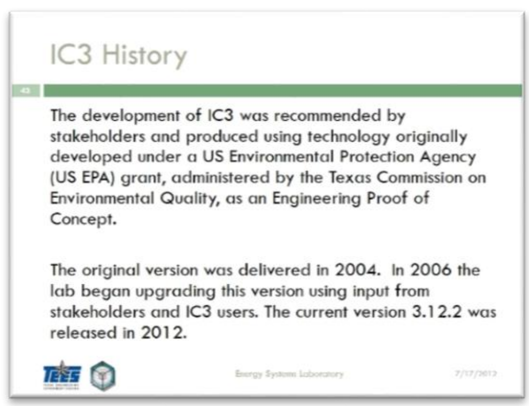
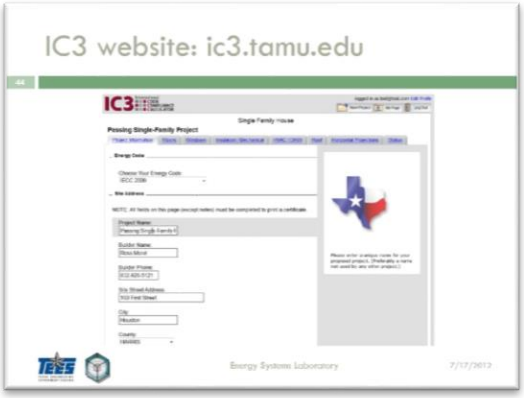
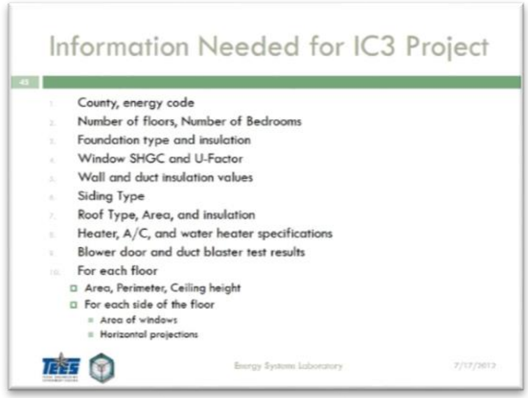
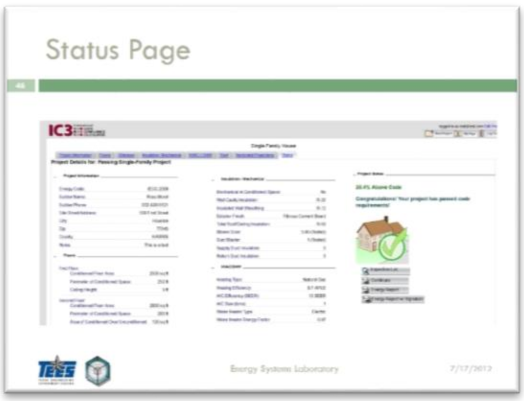
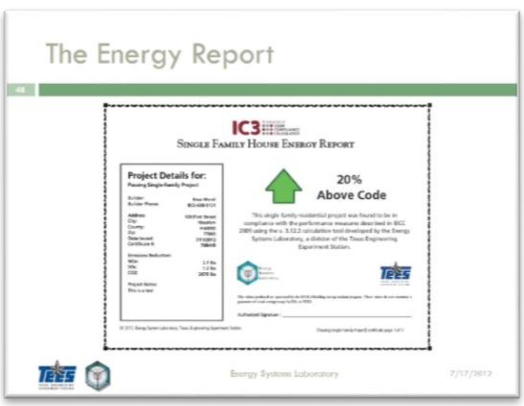


Figure 39: Presentation –TERP Stakeholder’s Meeting, July 2012 (Continued)









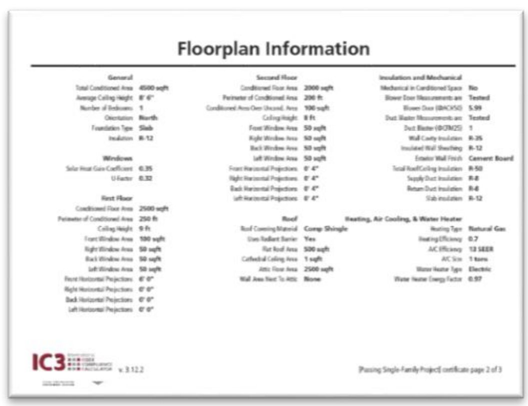
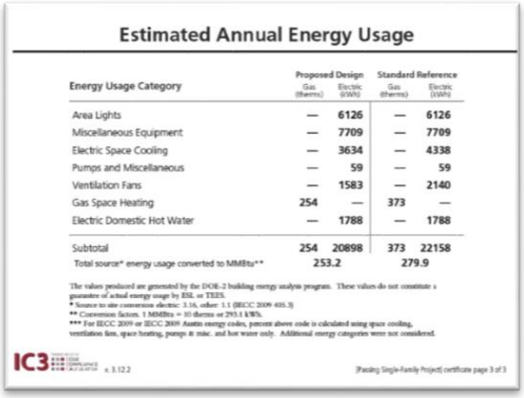
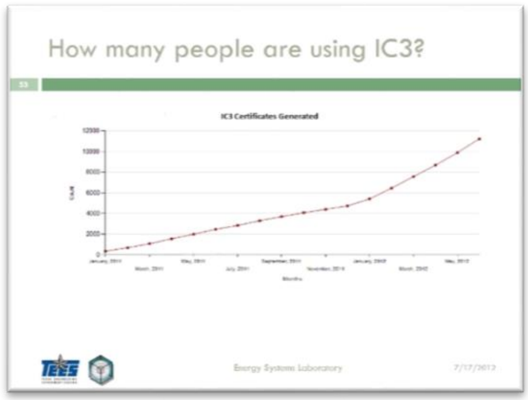
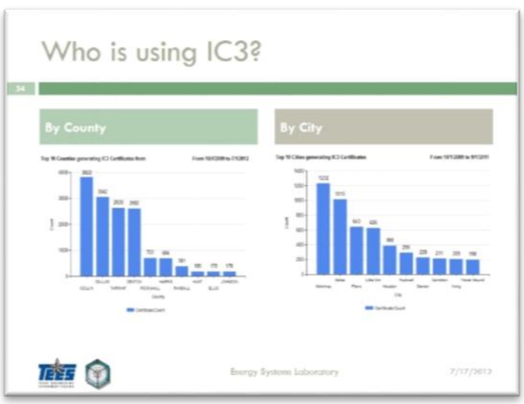


Figure 39: Presentation –TERP Stakeholder’s Meeting, July 2012 (Continued)







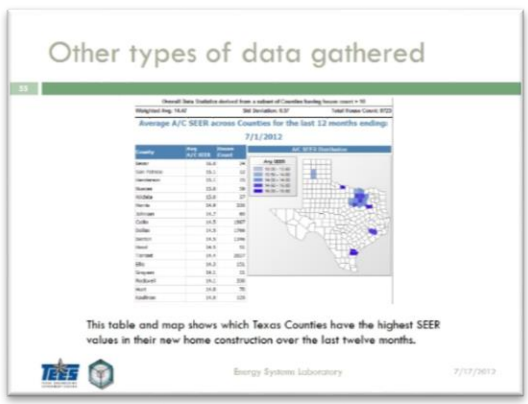


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)

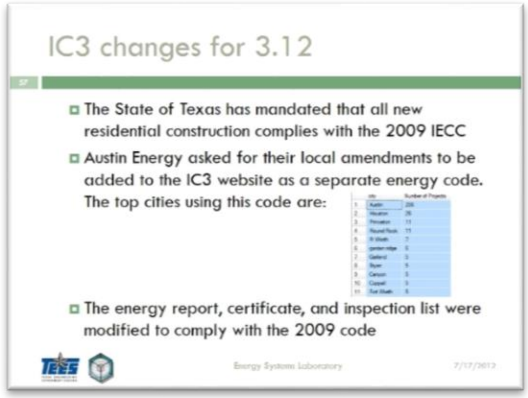
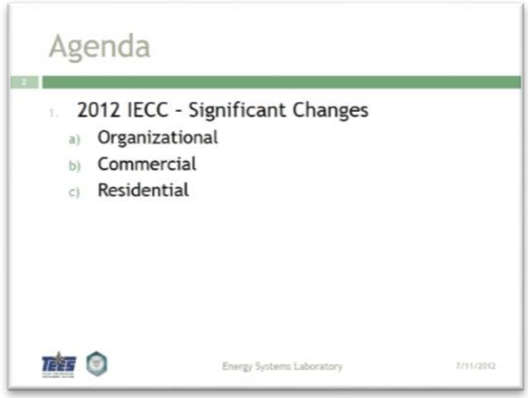
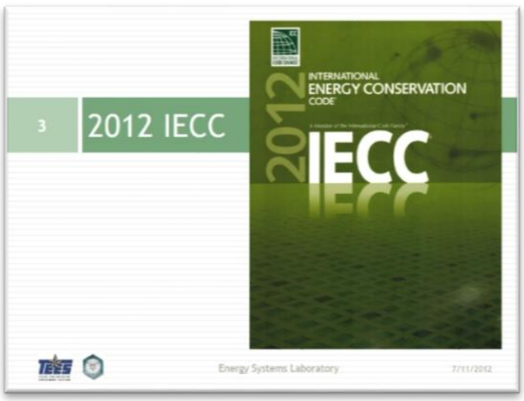
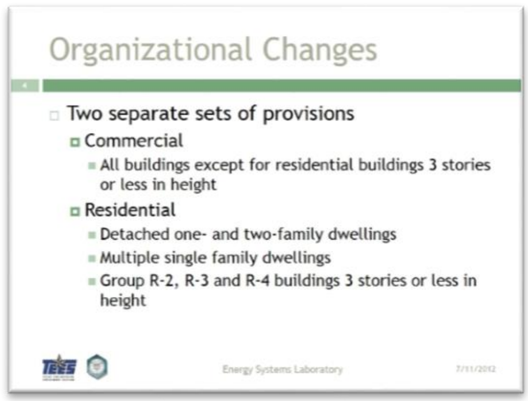


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)







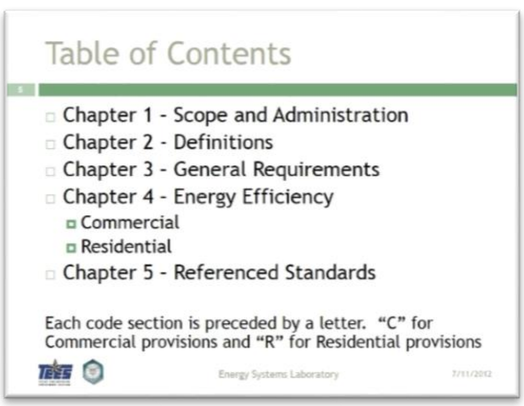
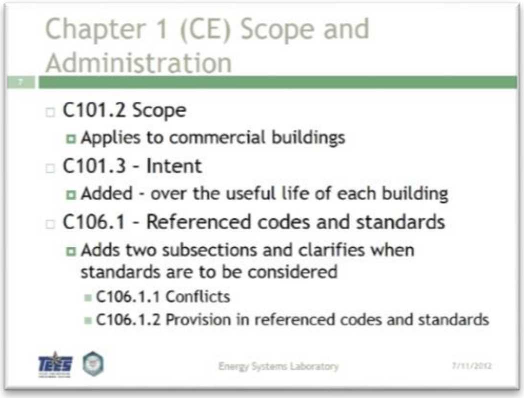
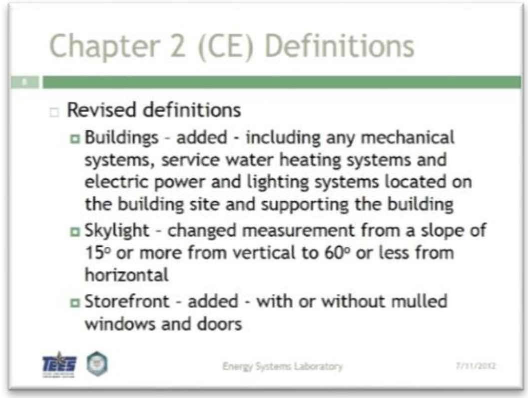
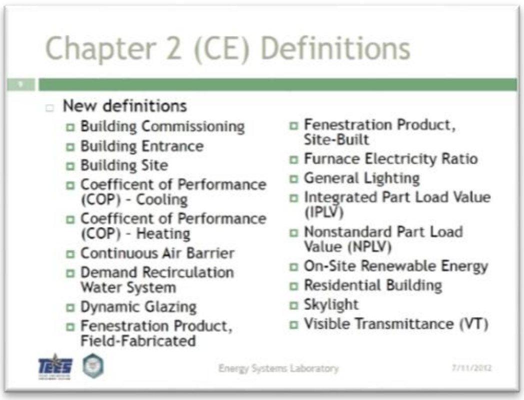
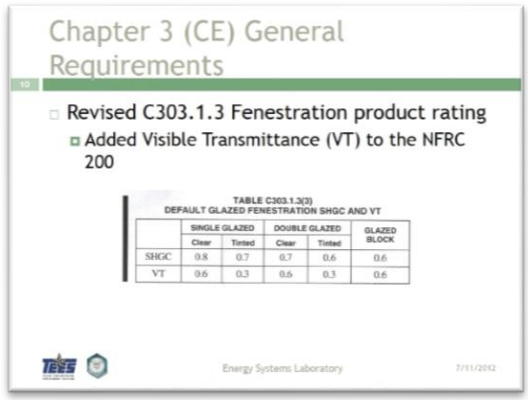


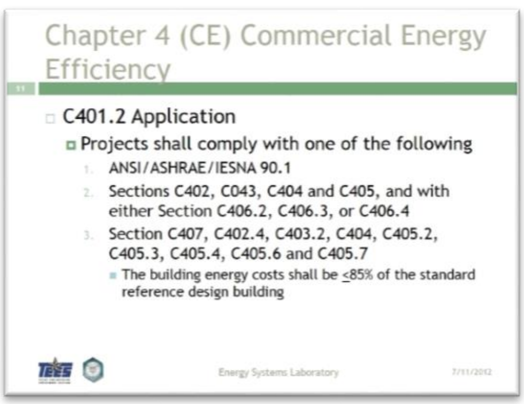
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)











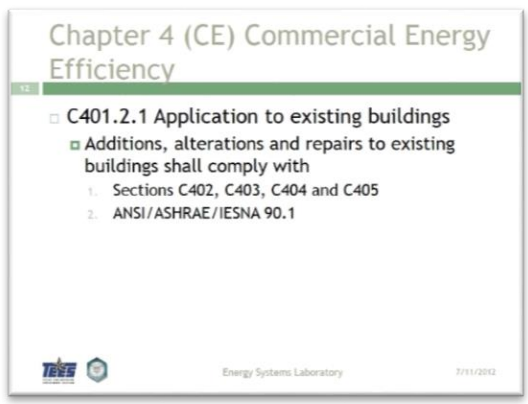
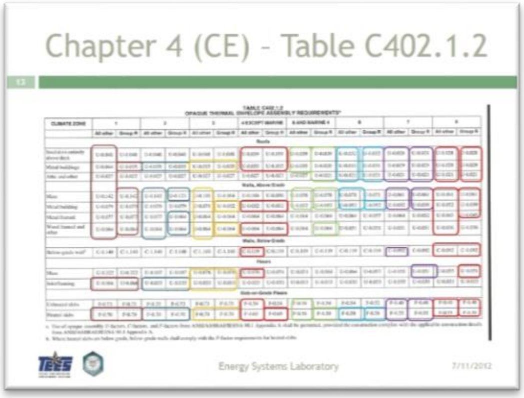
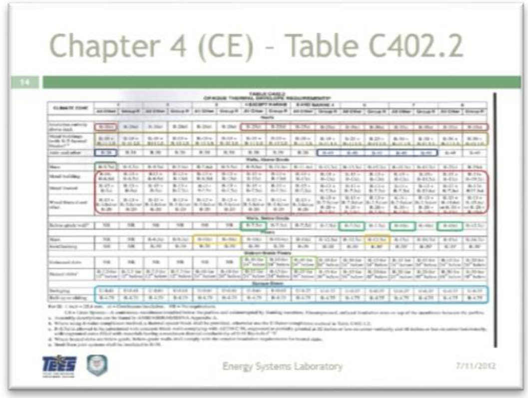
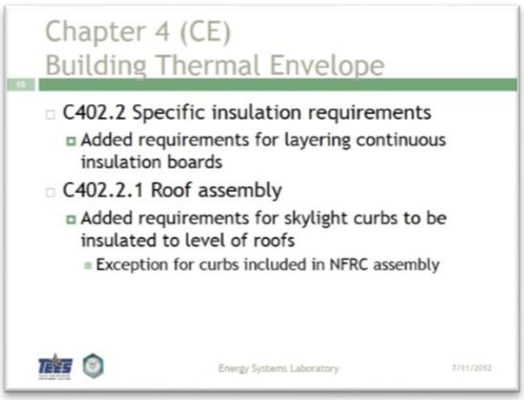
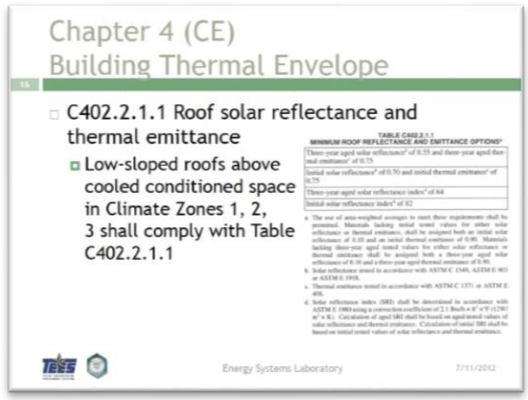


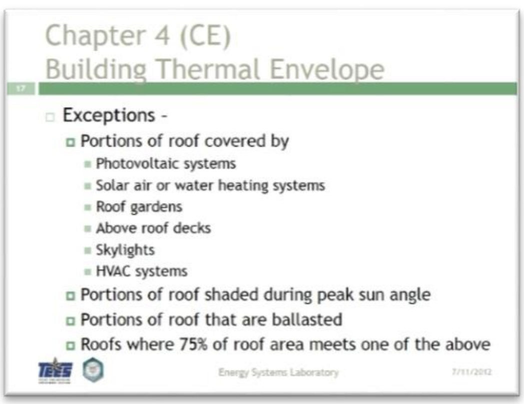
Figure 39: Presentation –TERP Stakeholder’s Meeting, July 2012 (Continued)











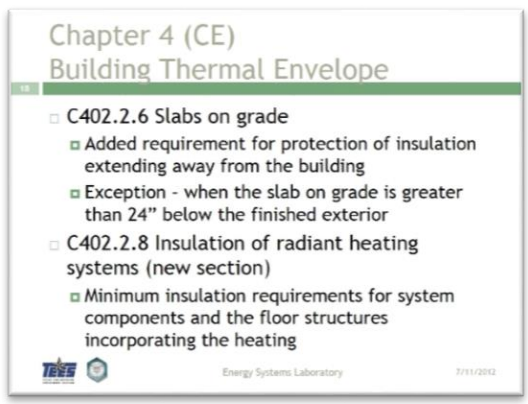


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)

Chapter 4 (CE) Fenestration

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- C402.3 Fenestration
  - C402.3.1 Maximum area - reduced to 30%
    - C402.3.1.1 Increased vertical fenestration area with daylighting controls
      - Increase max fenestration to 40% provided
        - No less than 50% of conditioned floor has daylighting
        - Automatic daylighting controls are used
        - VT of fenestration is 1.1 times SHGC
          - Exception - fenestration outside scope of NFRC 200
    - C402.3.1.2 Increased skylight area with daylighting controls - increased to 5%

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Table C402.3

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TABLE C402.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
U-factor								
Fixed fenestration	0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29
Operable fenestration	0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37
Entrance doors	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77
SHGC								
SHGC	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
Skylights								
U-factor	0.75	0.65	0.55	0.50	0.50	0.50	0.50	0.50
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.

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Chapter 4 (CE) Fenestration

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- C402.3.2 Minimum skylight fenestration area (new section)
  - Enclosed space greater than 10,000 sq. ft.,
  - Directly under a roof with ceiling heights greater than 15 feet, and
  - Used as an office, lobby, atrium, concourse, corridor, storage, gym/exercise center, convention center, auto service, manufacturing, non-refrigerated warehouse, retail store, distribution area, transportation or workshop

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Minimum Skylights

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- Total daylight - not less than half the floor area and provide a minimum skylight to daylight of either
  - Not less than 3% of a skylight VT of at least 0.40
  - Provide a minimum skylight effective aperture of at least 1% determined in accordance with Equation 4-1
  - Exceptions

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Chapter 4 (CE) Fenestration

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- C402.3.2.1 Lighting controls in daylight zones under skylights (new section)
  - All lighting in the daylight zone shall be controlled by multilevel lighting controls
  - Exceptions
- C402.3.2.2 Haze factor
  - Skylights in listed occupancies shall have a glazing material or diffuser with a measured haze factor greater than 90% when tested according to ASTM 1003
  - Exceptions

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Chapter 4 (CE) Fenestration

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- C402.3.3 Maximum *U*-factor and SHGC
  - Additional language - "Where different windows or glass doors have different PF values, they shall each be evaluated separately"
- C402.3.3.1 SHGC adjustment
  - Where the PF is greater than or equal to 0.2, the required maximum SHGC shall be adjusted using Table C402.3.3.1

TABLE C402.3.3.1
SHGC ADJUSTMENT MULTIPLIERS

PROJECTION FACTOR	ORIENTED WITHIN 45 DEGREES OF TRUE NORTH	ALL OTHER ORIENTATION
$0.2 \le PF < 0.5$	1.1	1.2
$PF \le 0.5$	1.2	1.6

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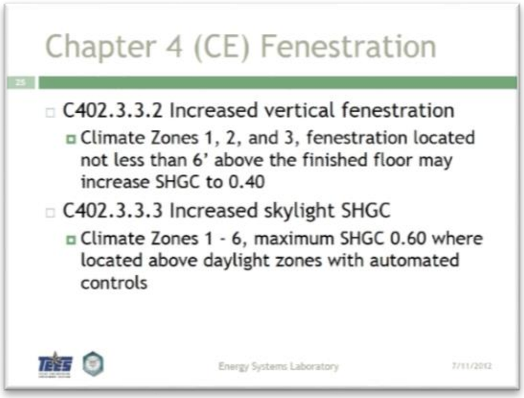
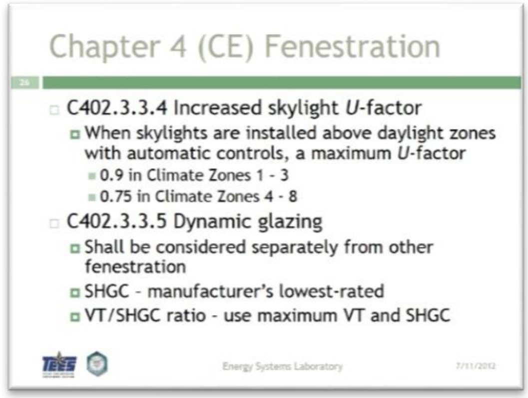
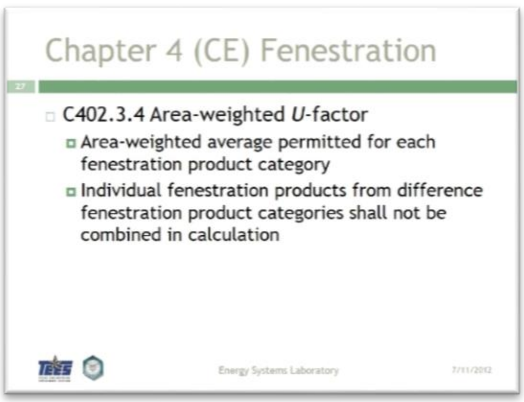
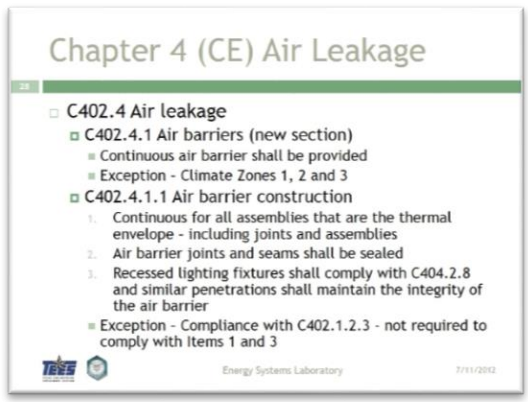
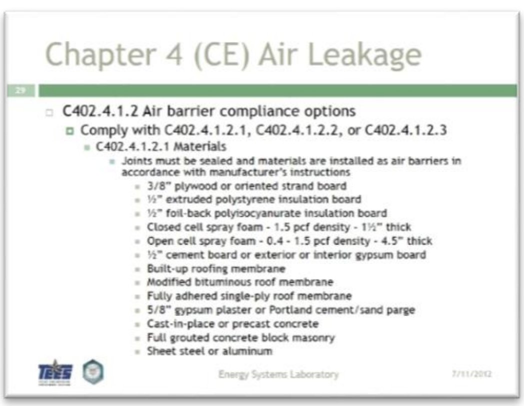
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)











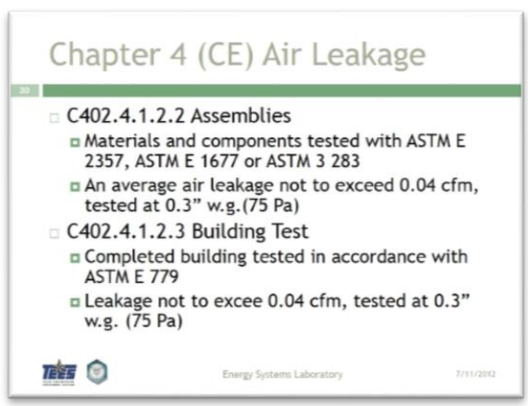


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)

Chapter 4 (CE) Air Leakage

- C402.4.2 Air barrier penetrations
  - Added language clarifying sealing requirements
- C402.4.3 Air leakage of fenestration
  - Table C402.4.3

**TABLE C402.4.3
MAXIMUM AIR INFILTRATION RATE
FOR FENESTRATION ASSEMBLIES**

FENESTRATION ASSEMBLY	MAXIMUM RATE (CFM/FT²)	TEST PROCEDURE
Windows	0.20[a]	AAMA/WDMA/ CSA101/I.S.2/A440 or NFRC 400
Sliding doors	0.20[a]	
Swinging doors	0.20[a]	
Skylights – with condensation weepage openings	0.30	
Skylights – all other	0.20[a]	
Curtain walls	0.06	NFRC 400 or ASTM E 283 at 1.57 psf (75 Pa)
Storefront glazing	0.06	
Commercial glazed swinging entrance doors	1.00	
Revolving doors	1.00	
Garage doors	0.40	ANSI/DASMA 105, NFRC 400, or ASTM E 283 at 1.57 psf (75 Pa)
Rolling doors	1.00	

For SI: 1 cubic foot per minute = 0.47L/s, 1 square foot = 0.093 m².
a. The maximum rate for windows, sliding and swinging doors, and skylights is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with AAMA/WDMA/CSA101/I.S.2/A440 at 6.24 psf (300 Pa).

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Chapter 4 (CE) Air Leakage

- C402.4.4 Doors and access openings to shafts chutes, stairways and elevator lobbies
  - Exception
- C402.4.5 Air intakes, exhaust openings, stairways and shafts
  - C402.4.5.1 Stairway and shaft vents
  - C402.4.5.2 Outdoor air intakes and exhausts
    - Exceptions

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Chapter 4 (CE) Air Leakage

- C402.4.7 Vestibules
  - Added all building entrances
  - Added the installation of revolving doors in the building entrance shall not eliminate the vestibule on any door adjacent to the revolving door
  - Exceptions
    - Added doors intended solely for employee use to exception 2

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Chapter 4 (CE) Air Leakage

- C402.4.8 Recessed lighting
  - Removed language addressing air movement from the conditioned space to the ceiling cavity.

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Chapter 4 (CE) Mechanical

- C403.2.1 Calculation of heating and cooling loads
  - Added - The design loads shall account for the building envelope, lighting, ventilation and occupancy loads based on the project design
- C403.2.2 Equipment and system sizing
  - Clarified the output capacity of heating and cooling equipment systems shall not exceed the loads calculated

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Chapter 4 (CE) Mechanical

- C403.2.3 HVAC equipment performance requirements
  - Added - Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of Table C403.2.3(9)
- C403.2.3.1 Water-cooled centrifugal chilling packages
  - Changed the formulas
    - Adjusted minimum full-load COP ratings
    - Adjusted minimum NPLV rating
  - Exception - chillers designed to operate outside these ranges need not comply

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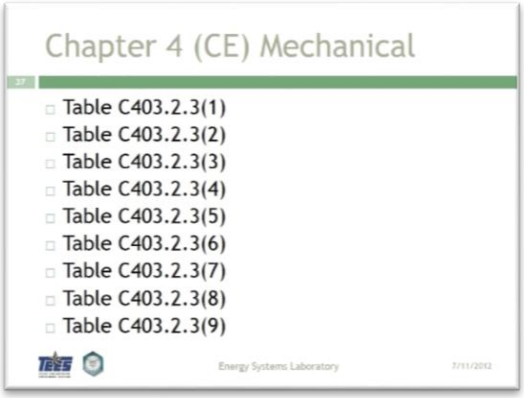
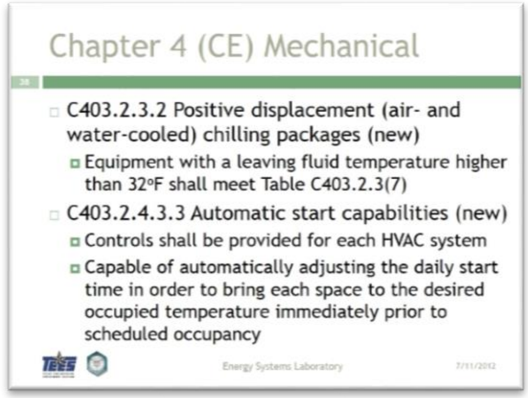
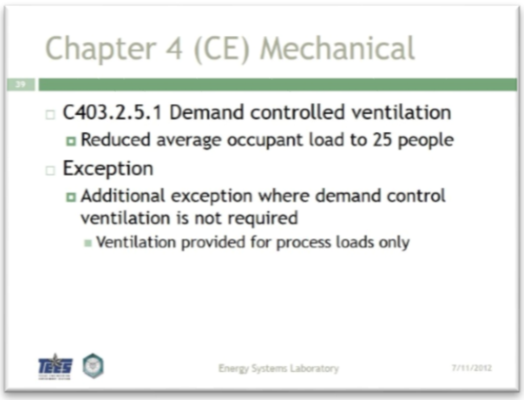
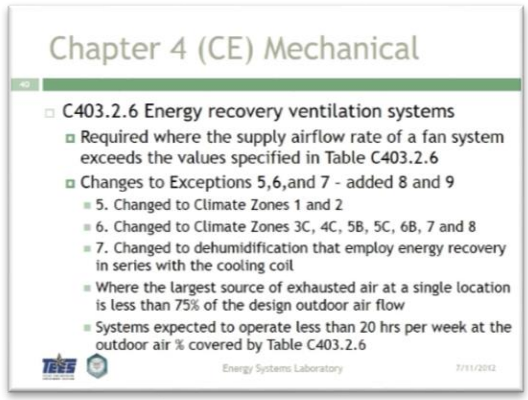
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)









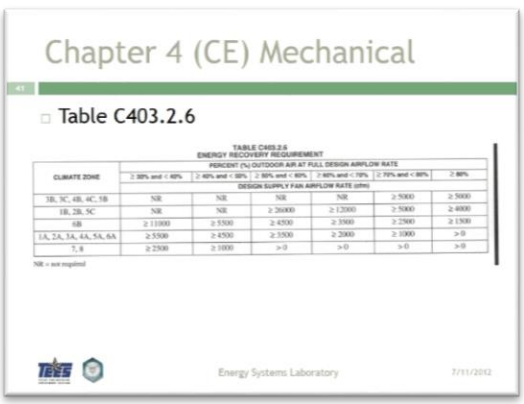


TABLE C403.2.6
ENERGY RECOVERY REQUIREMENT

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE					
	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
	DESIGN SUPPLY FAN AIRFLOW RATE (cfm)					
3B, 3C, 4B, 4C, 5B	NR	NR	NR	NR	≥ 5000	≥ 5000
1B, 2B, 5C	NR	NR	≥ 26000	≥ 12000	≥ 5000	≥ 4000
6B	≥ 11000	≥ 5500	≥ 4500	≥ 3500	≥ 2500	≥ 1500
1A, 2A, 3A, 4A, 5A, 6A	≥ 5500	≥ 4500	≥ 3500	≥ 2000	≥ 1000	> 0
7, 8	≥ 2500	≥ 1000	> 0	> 0	> 0	> 0

NR = not required

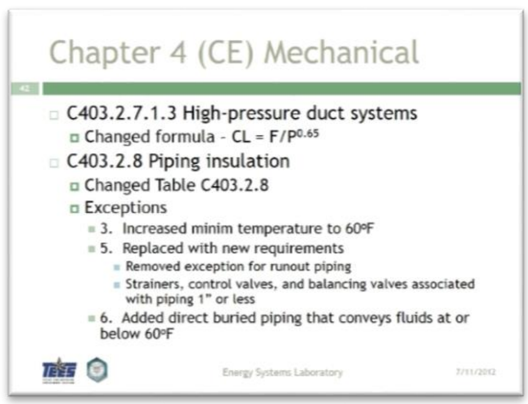
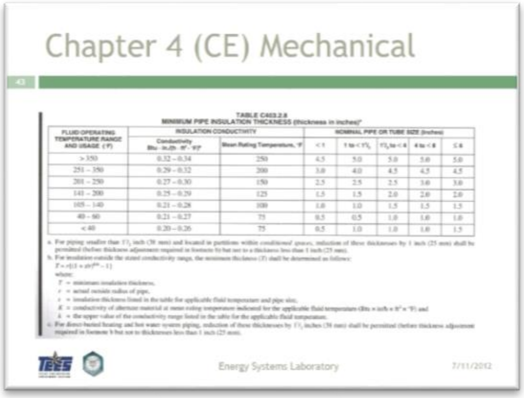
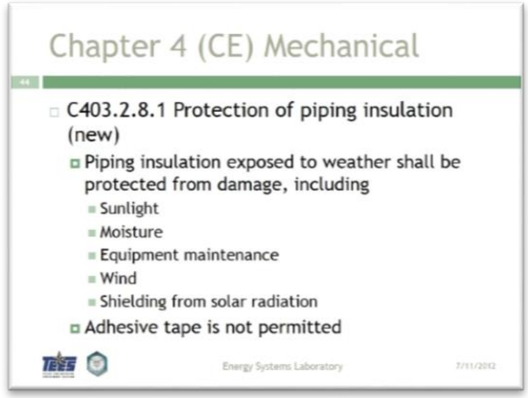
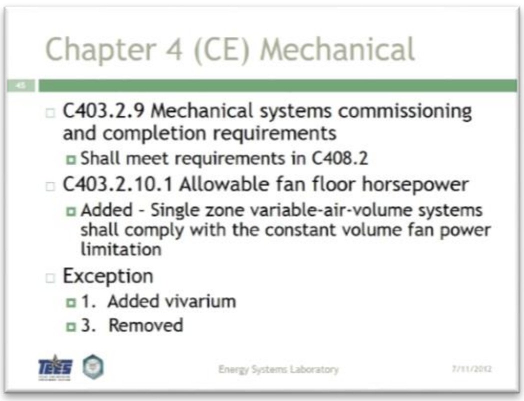
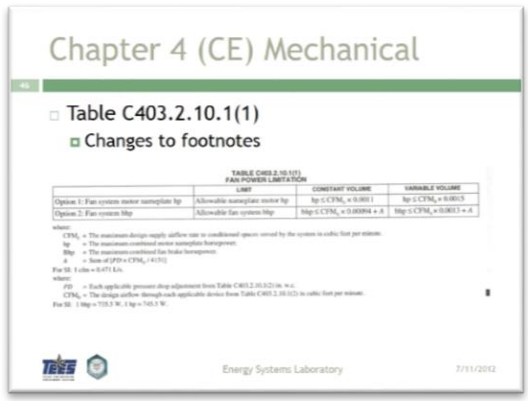


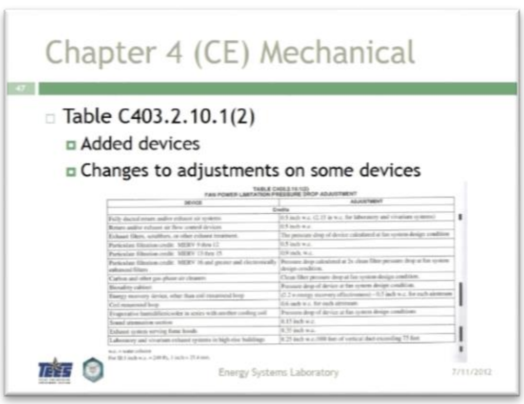
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)











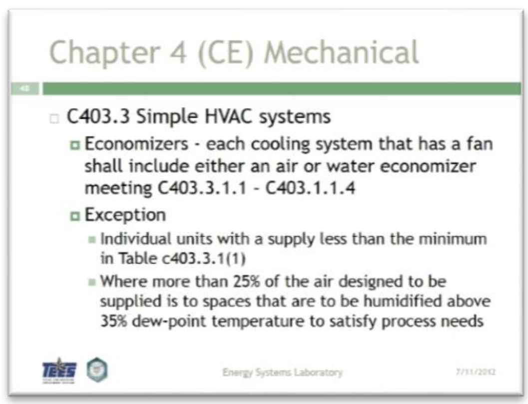


Figure 39: Presentation –TERP Stakeholder’s Meeting, July 2012 (Continued)

Chapter 4 (CE) Mechanical

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- C403.3 Simple HVAC systems
  - Economizers -Exceptions continued
    - Systems that serve residential spaces where the capacity is less than five times the requirement listed in Table C403.3.1(1)

TABLE C403.3.1(1)
ECONOMIZER REQUIREMENTS

CLIMATE ZONES	ECONOMIZER REQUIREMENT
1A, 1B	No requirement
2A, 2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8	Economizers on all cooling systems ≥ 33,000 Btu/h[a]

For SI: 1 British thermal unit per hour = 0.2931 W.
a. The total capacity of all systems without economizers shall not exceed 300,000 Btu/h per building, or 20 percent of its air economizer capacity, whichever is greater.

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Chapter 4 (CE) Mechanical

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- C403.3 Simple HVAC systems
  - Economizers -Exceptions continued
    - Systems expected to operate less than 20 hours a week
    - Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems
    - Where the cooling efficiency meets or exceeds the efficiency requirements in Table C403.3.1(2)

TABLE C403.3.1(2)
EQUIPMENT EFFICIENCY PERFORMANCE
EXCEPTION FOR ECONOMIZERS

CLIMATE ZONES	COOLING EQUIPMENT PERFORMANCE IMPROVEMENT (EER OR IPLV)
2B	10% Efficiency Improvement
3B	15% Efficiency Improvement
4B	20% Efficiency Improvement

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- C403.3.1.1 Air economizers (new)
  - C403.3.1.1.1 Design capacity
    - System shall be capable of modulating outdoor air and return air dampers to provide up to 100% of design supply air quantity as outdoor air for cooling
  - C403.3.1.1.2 Control signal
    - Dampers capable of being sequenced with the cooling equipment and not controlled only by mixed air temperature
    - Exception
      - Use of mixed air temperature limit control shall be permitted for some systems such as single-zone systems

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Chapter 4 (CE) Mechanical

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- C403.3.1.1.3 High-limit shutoff
  - Capable of automatically reducing outdoor air intake to the minimum quantity when intake will not longer reduce cooling energy usage
  - High-limit shutoff control types for specific climates shall be from Table C403.3.1.1.3(1)
  - High-limit shutoff control settings for these control types shall be as specified in Table C403.3.1.1.3(2)

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- C403.3.1.1.4 Relief of excess outdoor air
  - Capable of relieving excess outdoor air during air economizer operation to prevent over-pressurizing the building.
  - Locate the relief valve to avoid recirculation into the building

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Chapter 4 (CE) Mechanical

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- C403.4 Complex HVAC systems
  - C403.4.1 Economizers
    - Removed air economizers
  - C403.4.1.1 Design capacity - water economizers
    - Cooling by indirect evaporation
    - Provide up to 100% of the expected cooling load
    - Outdoor air temperatures of 50°F dry bulb/45°F wet bulb
    - Expected system cooling load at 45°F dry bulb/40°F wet bulb
  - Exception
    - Where dehumidification requirements cannot be met

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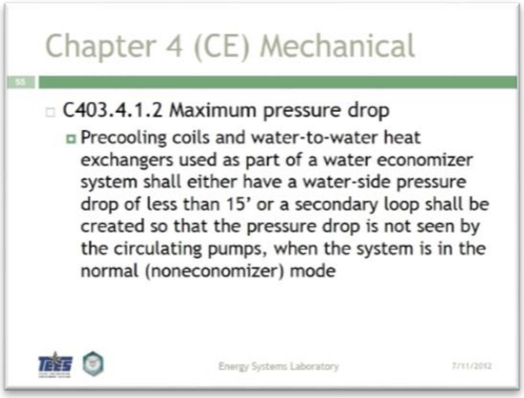
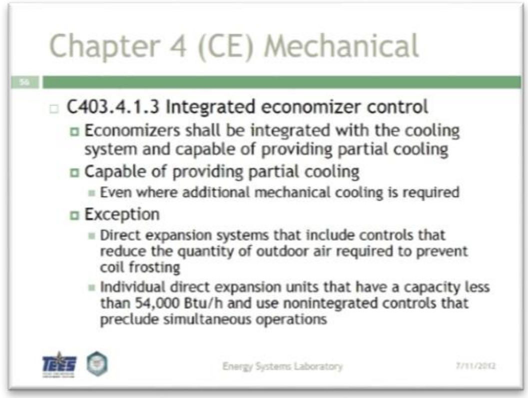
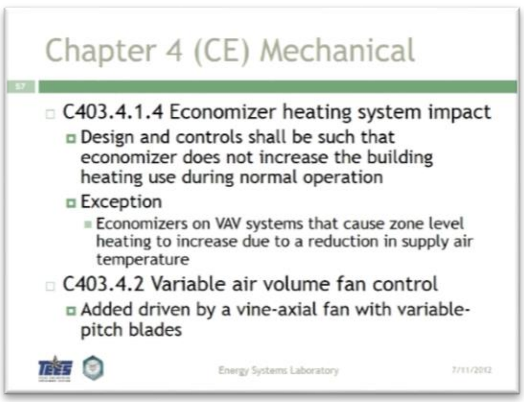
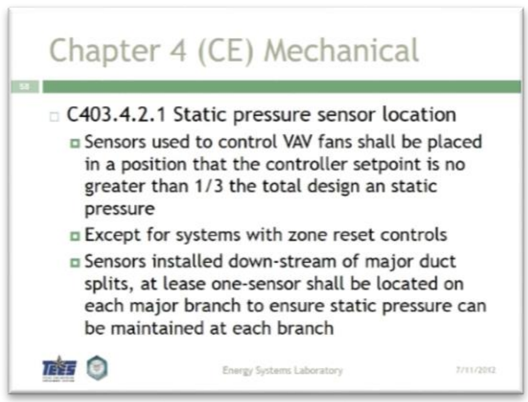
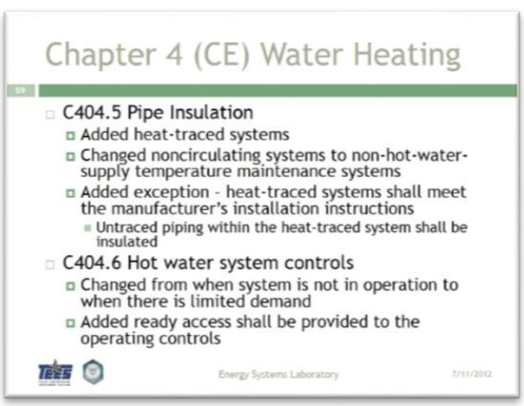
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)











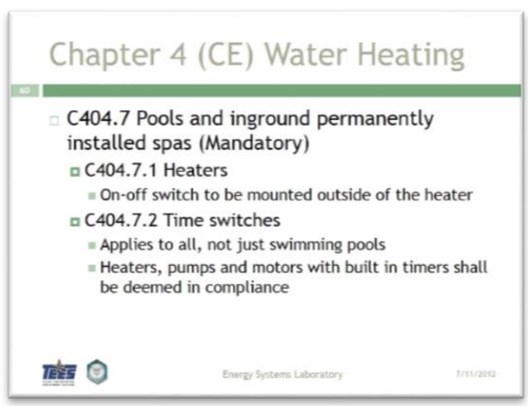
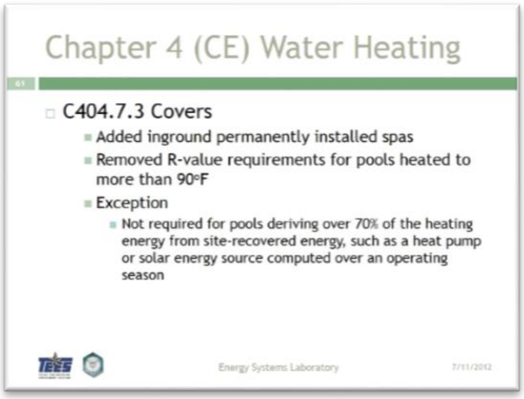
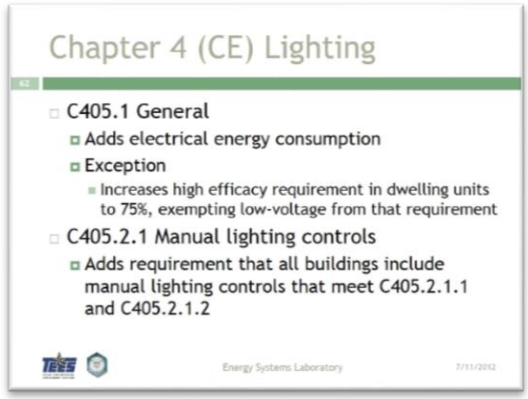
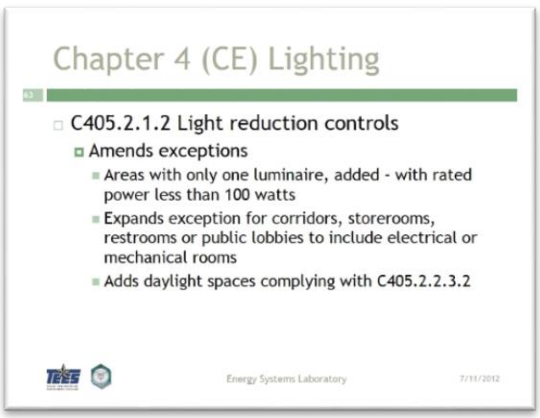
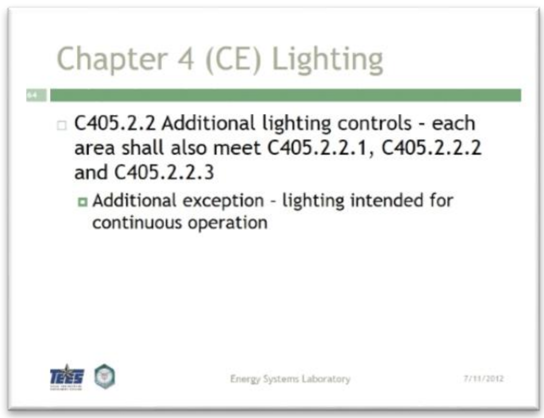


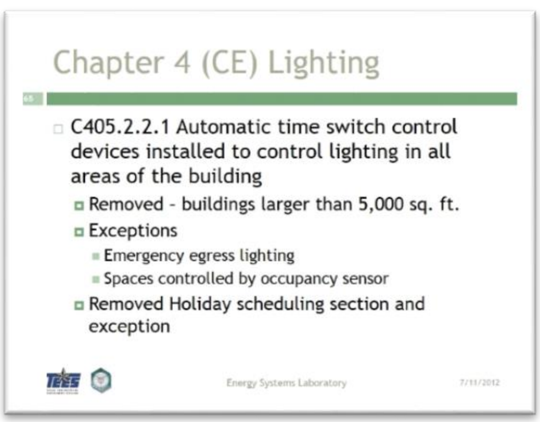
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)











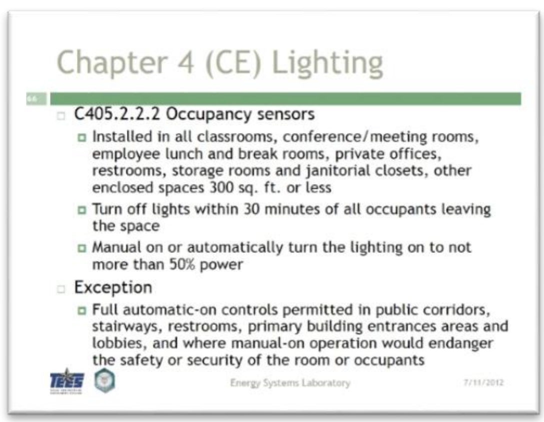


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)

Chapter 4 (CE) Lighting

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- C405.2.2.3 Daylight zone control - add limitation of 2500 sq. ft. per control zone
  - Exception - zones enclosed by wall or partitions and containing two or fewer luminaires not required to have a separate switch for general lighting
- C405.2.2.3.1 Manual daylighting controls (new)
  - Required unless automatic controls are installed

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Chapter 4 (CE) Lighting

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- C405.2.2.3.2 Automatic daylighting controls
  - Setpoint and other controls for calibrating lighting control device shall be readily accessible
  - Reduce the lighting power in response to available daylight by either
    - Continuous dimming using dimming ballast to reduce power to less than 35% of rated power
    - Stepped down dimming, using multi-level switching
    - Two control channels per zone
      - One step between 50% and 70% of design lighting power
      - Another step no greater than 35% of design power

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Chapter 4 (CE) Lighting

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- C405.2.2.3.3 Multi-level lighting controls
  - When multi-level controls are required the general lighting shall be controlled separately by at least one multi-level control that reduces the lighting power in response to daylight available
  - Where the daylight illuminance is greater than the rated illuminance of the general lighting, the general lighting is automatically controlled so that its power draw is no greater than 35% of its rated power
  - Located so that calibration and set point adjustment controls are readily accessible and separate from the light sensor

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- C405.2.3 Specific application controls
  - Dedicated controls independent of the controls for other lighting with in the room or space required for
    - Display and accent light
    - Lighting in display cases
    - Lighting for nonvisual applications
      - Plant growth
      - Food warming
    - Lighting equipment for sale or demonstration in lighting education
  - Hotel and motel sleeping units and guest suites
    - Removed exception for the bathroom
  - Supplemental task lighting
    - Permanently installed under shelf/cabinet lighting
    - Control device integral to the luminanires or readily accessible wall-mounted control device

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Chapter 4 (CE) Lighting

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- C405.5.2 Interior lighting power determined by
  - Building Area Method
    - Interior lighting power allowance = the floor area for each building area type listed x the value from Table C405.5.2(1)
  - Space-by-Space Method
    - Interior lighting power allowance = the floor area of each space x the value for the space type in Table C405.5.2(2) that most closely represents the proposed use of the space and then summing the lighting power allowances for all spaces
    - Tradeoffs among spaces are permitted

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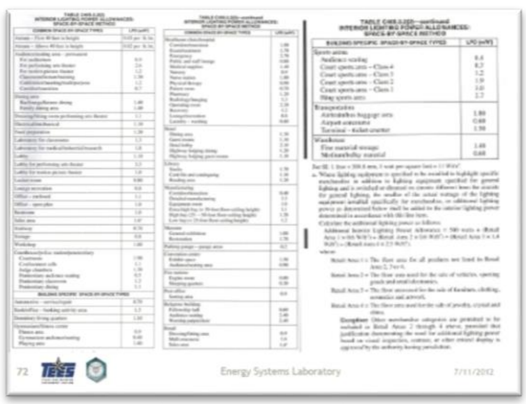
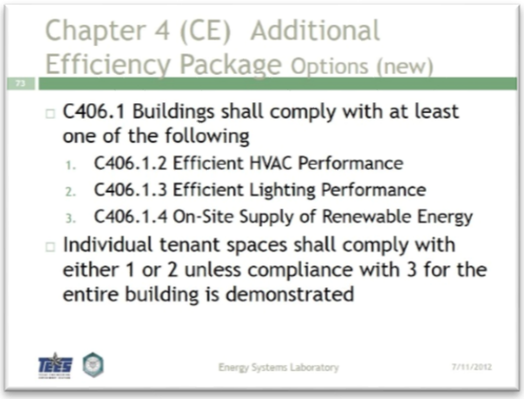
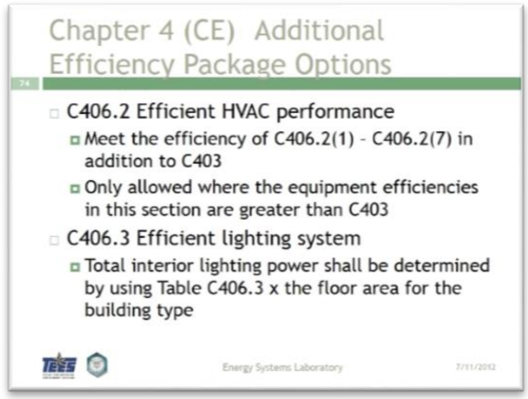
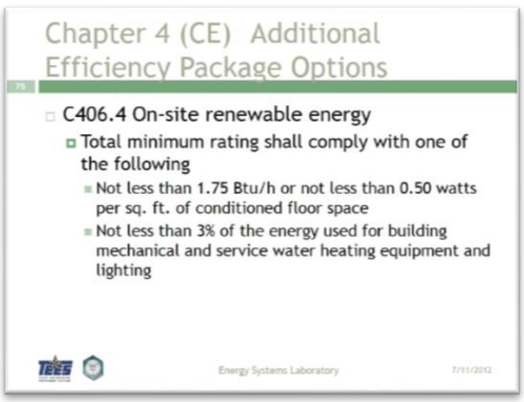
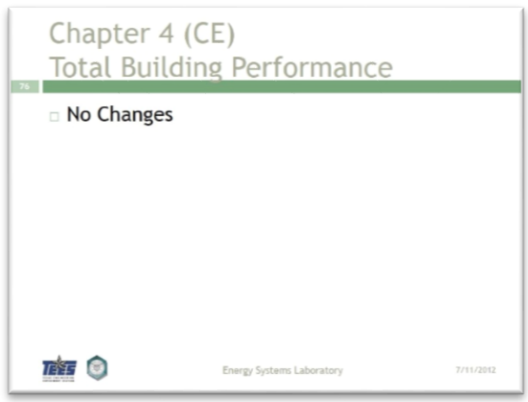


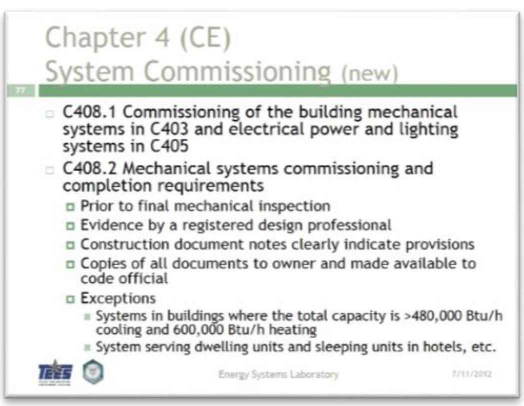
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)











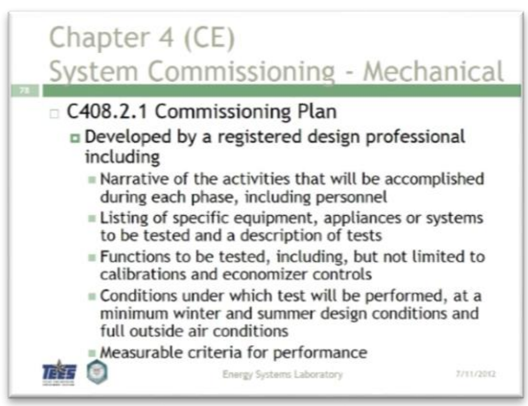
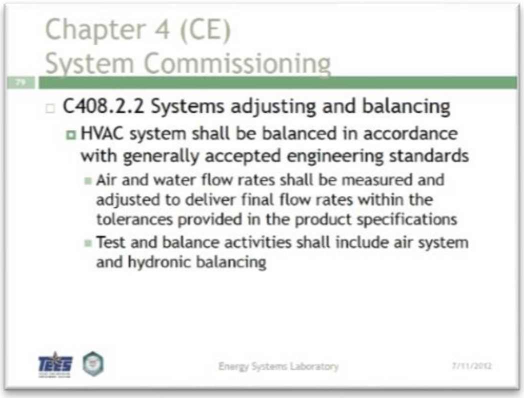
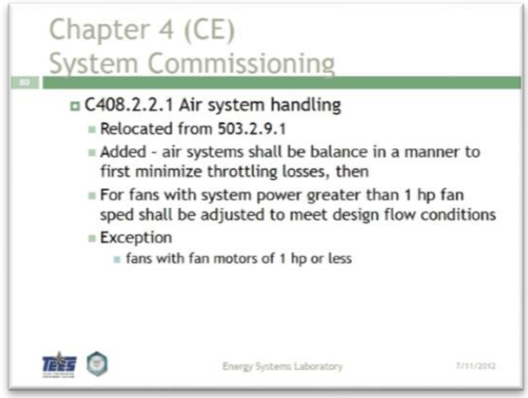
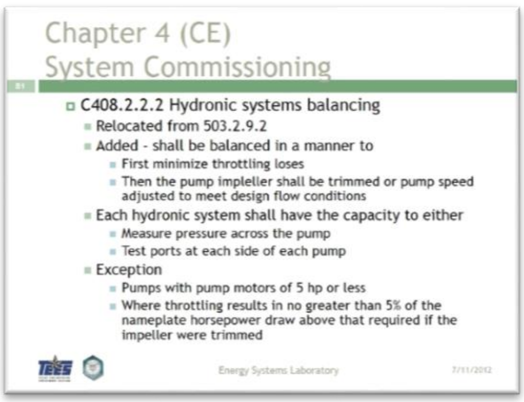
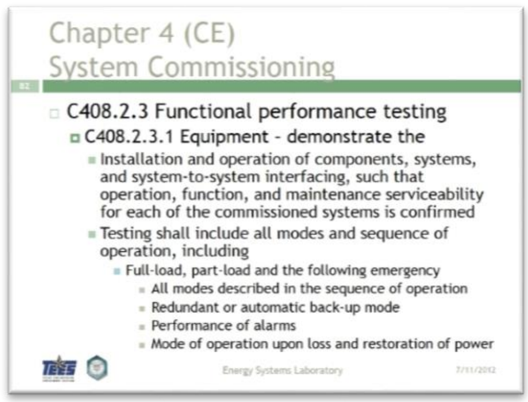


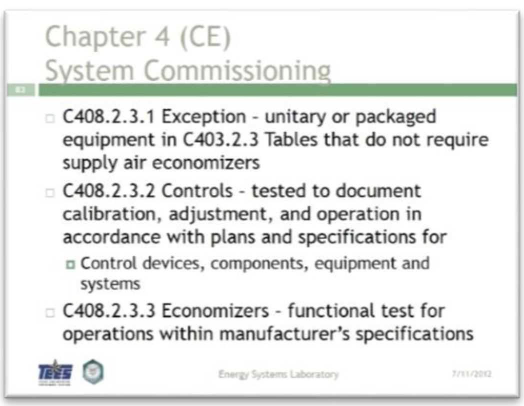
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)











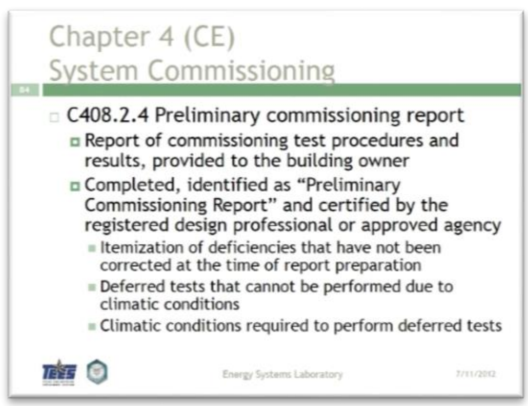
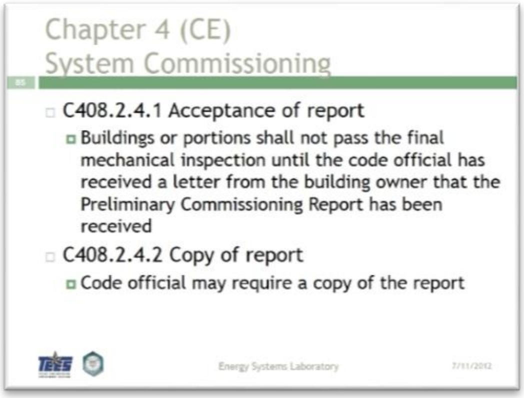
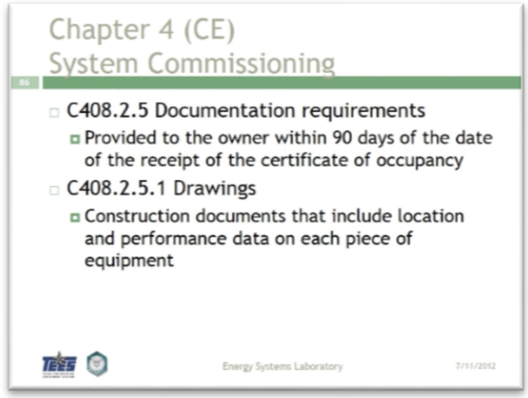
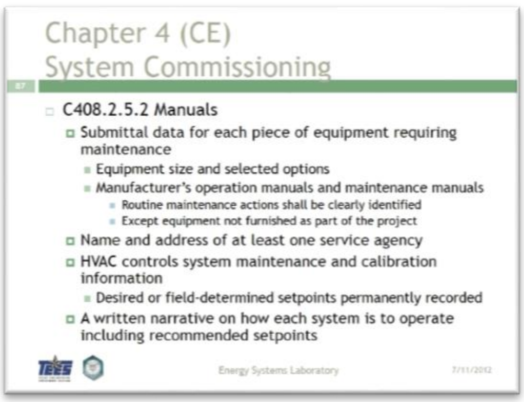
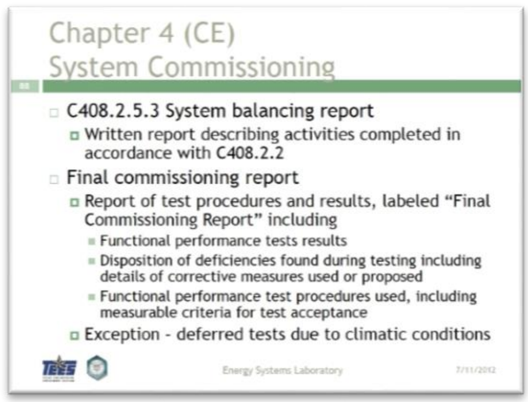


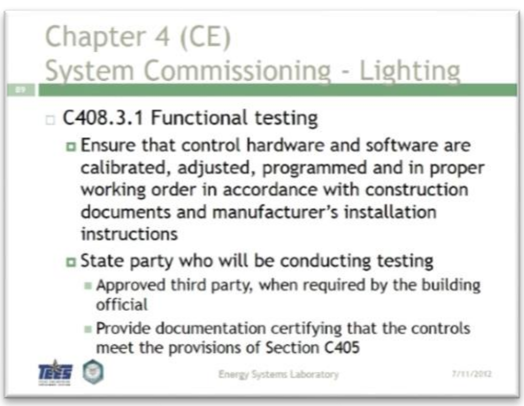
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)











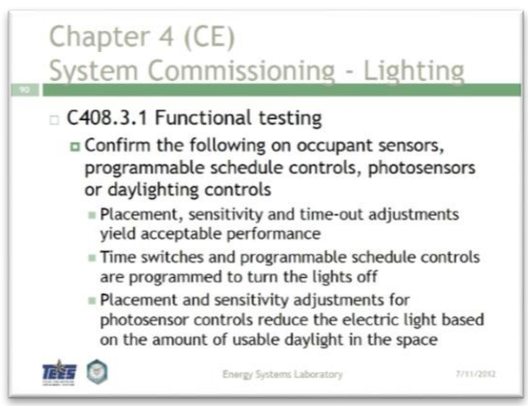
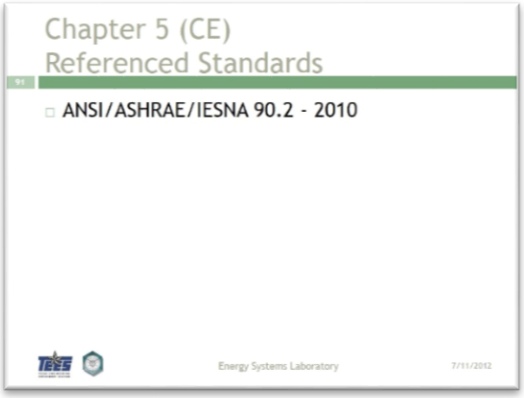
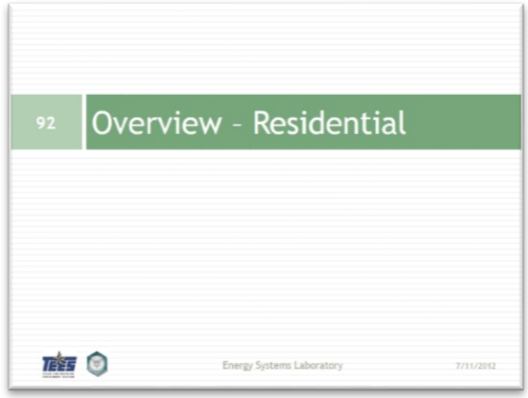
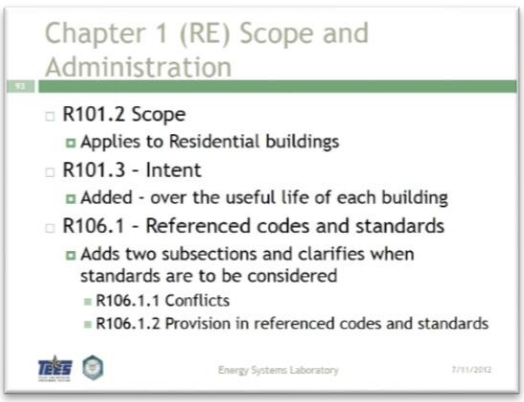
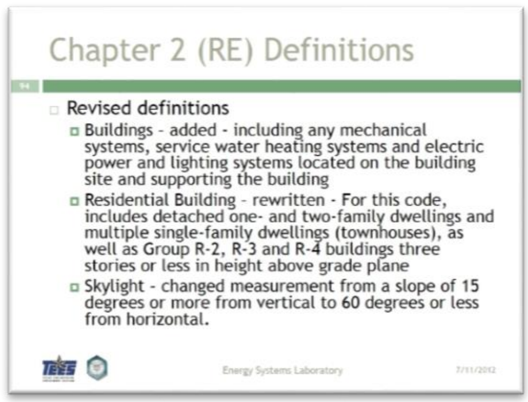


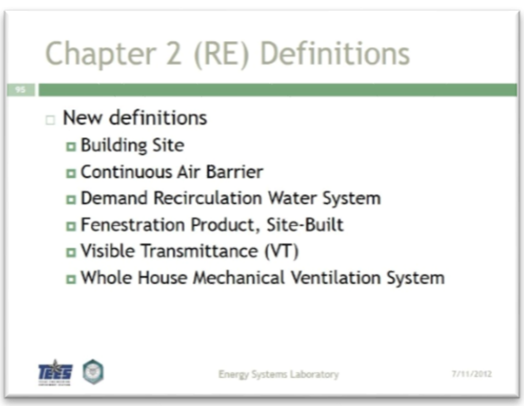
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)

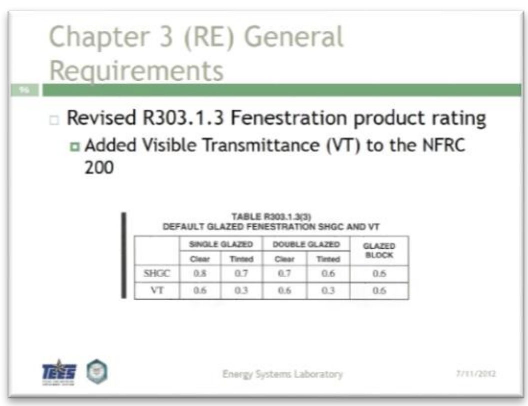






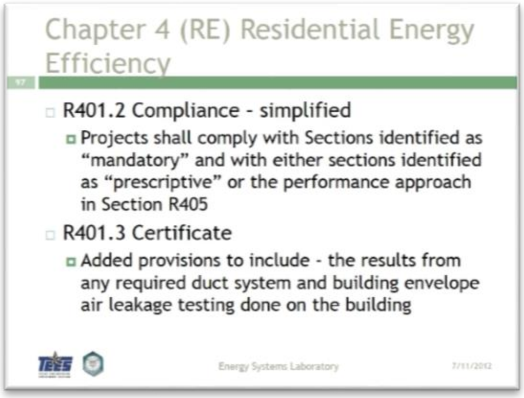


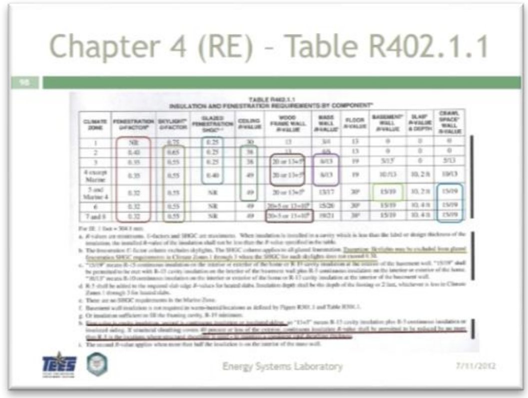


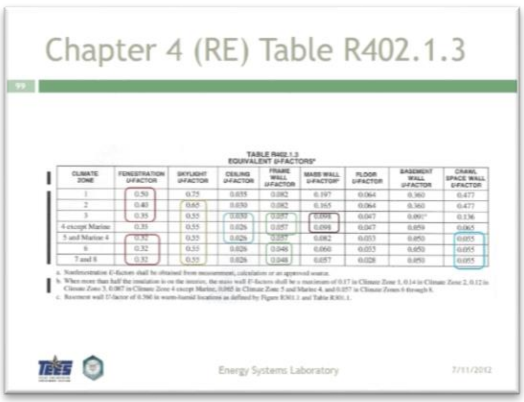


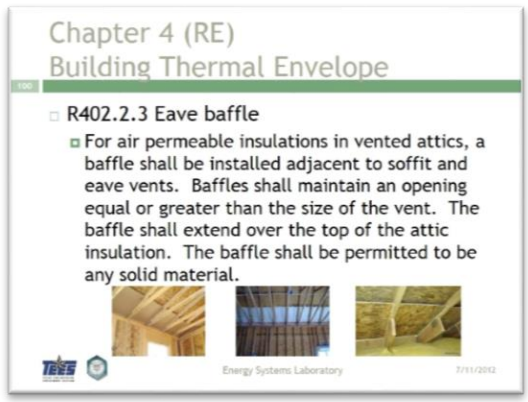
	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

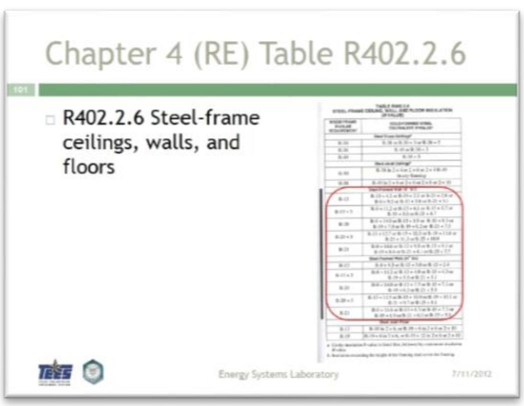
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)











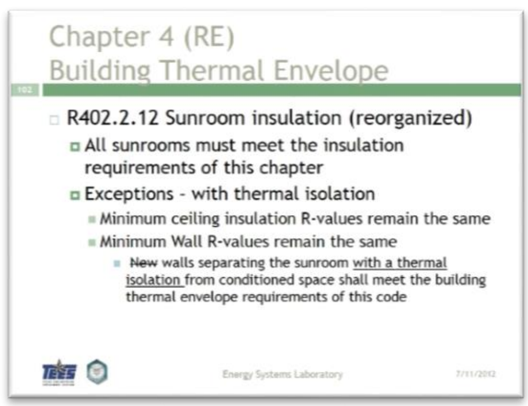


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)

Chapter 4 (RE) Building Thermal Envelope

- R402.2.3.5 Sunroom *U*-factor
  - All sunrooms enclosing conditioned space must meet the fenestration requirements of this chapter
  - Exception - sunrooms with thermal isolation and enclosing conditioned space
    - Climate Zones 4 - 8
      - Maximum *U*-factor 0.45
      - Maximum skylight *U*-factor 0.70
    - New fenestration separating the sunroom from the conditioned space shall meet the building thermal envelope requirements

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Chapter 4 (RE) Air Leakage

- R402.4 Air leakage
  - R402.4.1 Building thermal envelope shall comply with Sections R402.4.1.1 and R402.4.1.2.
    - The sealing methods between dissimilar material shall allow for differential expansion and contraction
    - Removed - the itemized list of where to caulk, gasket, weatherstrip or otherwise seal with an air barrier material, suitable film or solid material

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Chapter 4 (RE) Building Thermal Envelope

- R402.4.1.1 Installation. The components of the building thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction
  - Where required by the code official, an approved third party shall inspect all components and verify compliance

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Chapter 4 (RE) Table R402.4.1.1

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Chapter 4 (RE) Air Leakage

- R402.4.1.2 Testing
  - The building or dwelling unit shall be tested with a blower door at a pressure of 0.2 w.g.(50 Pa)and verified as having an air leakage rate of not exceeding
    - 5 air changes per hour - Climate Zones 1 and 2
    - 3 air changes per hour - Climate Zones 3 through 8
  - Where required by the code official, testing shall be conducted by an approved third party
  - A written report of the results shall be signed by the party conducting the test and provided to the code official

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Chapter 4 (RE) Air Leakage

- R402.4.1.2 Testing shall be performed at any time after the creating of all penetrations of the building thermal envelope. During testing:
  - Exterior windows and doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures;
  - Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;
  - Interior doors, if installed at the time of the test, shall be open
  - Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
  - Heating and cooling systems, if installed at the time of the test, shall be turned off; and
  - Supply and return register, if installed at the time of the test, shall be fully open
- ~~402.4.2.2 Visual inspection option~~

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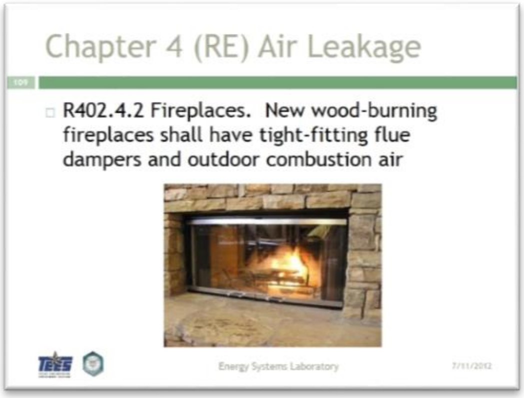
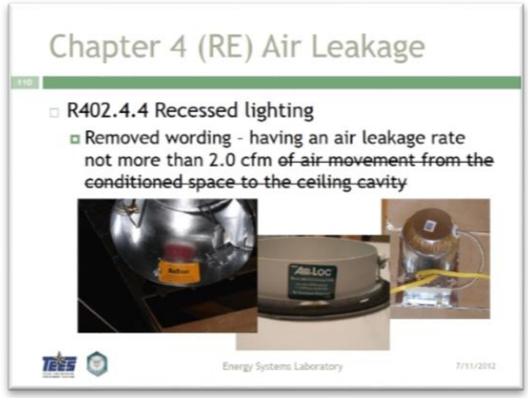
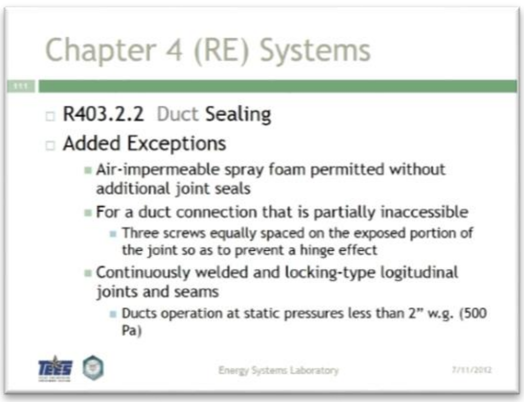
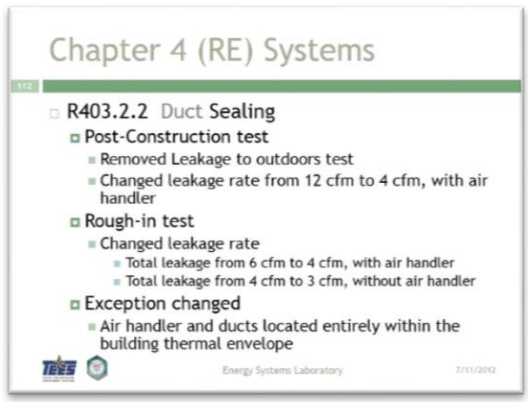
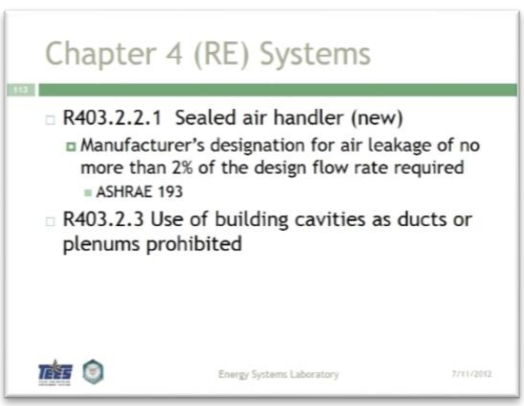
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)











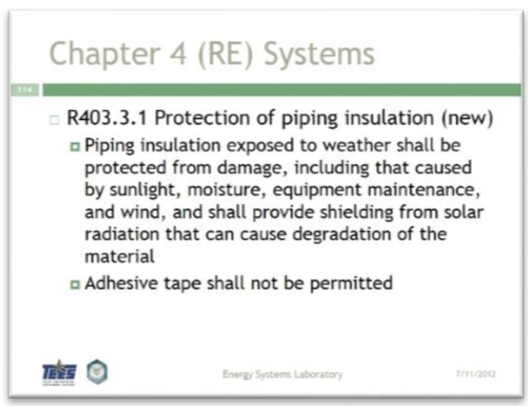
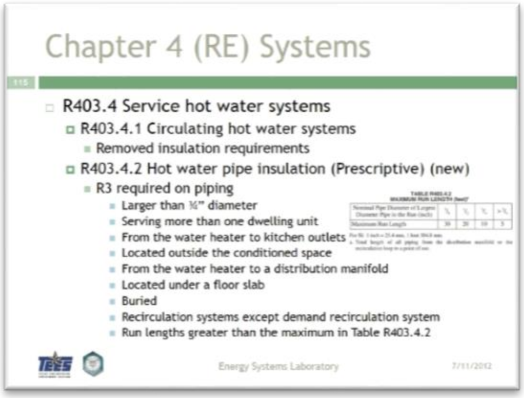
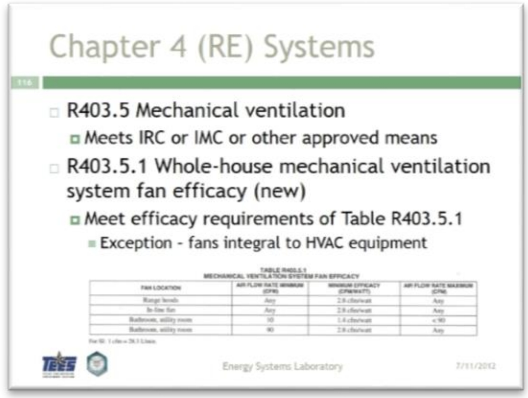
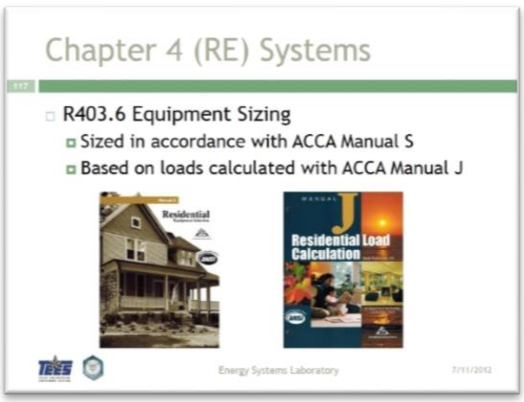
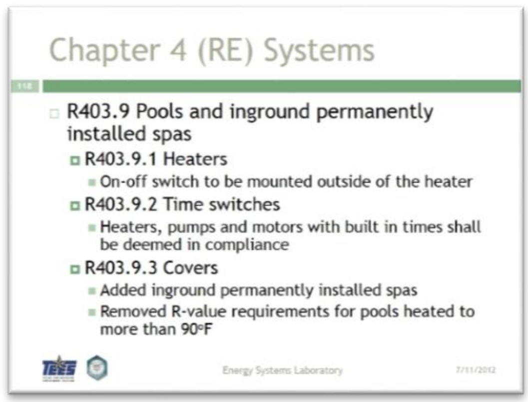


Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)









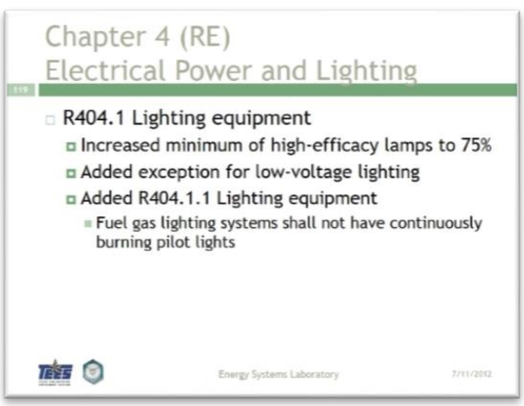
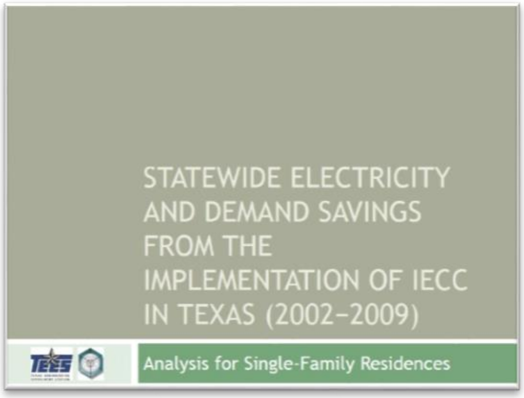
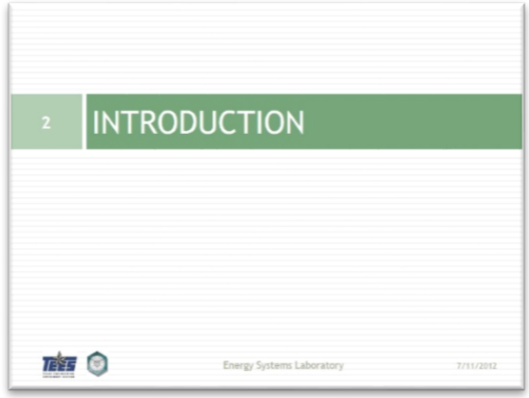
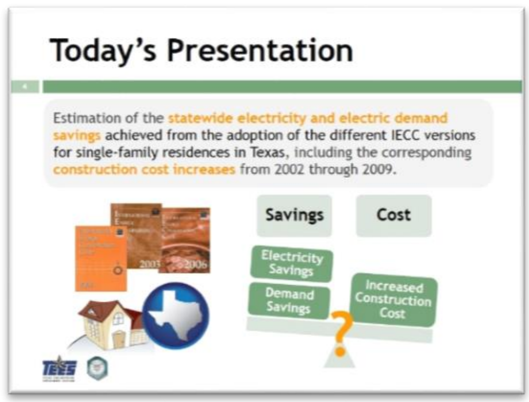


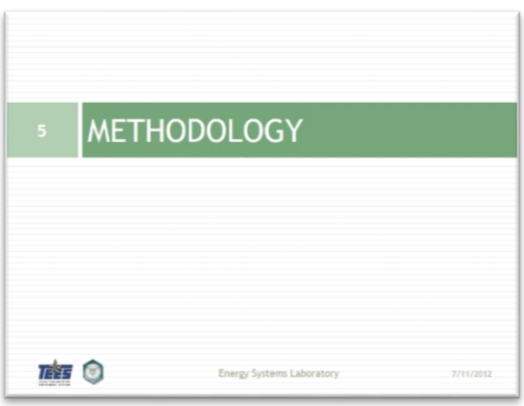
Figure 39: Presentation –TERP Stakeholder's Meeting, July 2012 (Continued)

Presentation –TERP Stakeholder's Meeting, August 2012









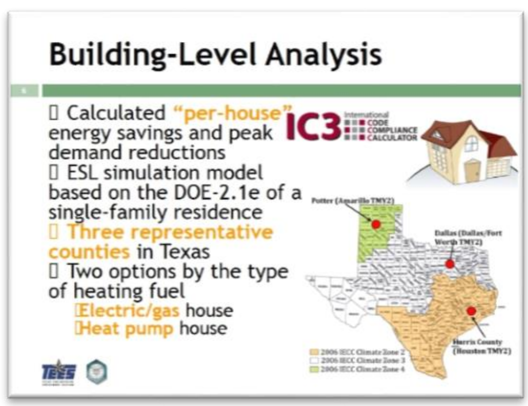
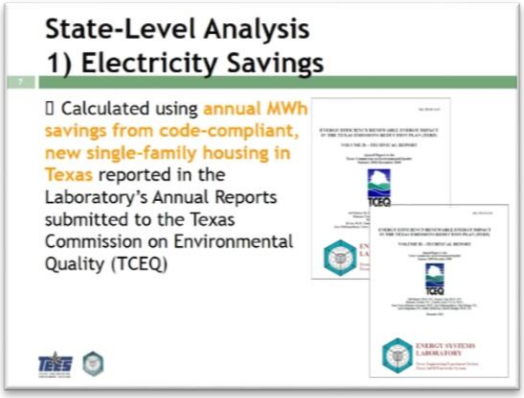
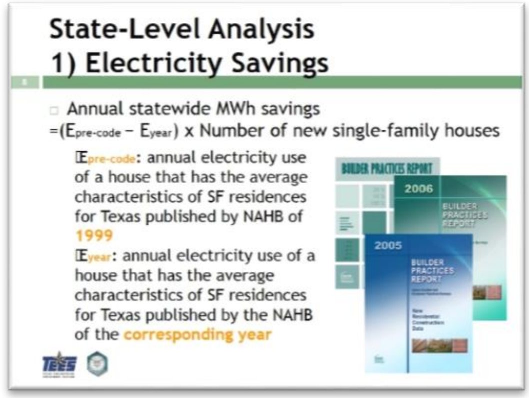
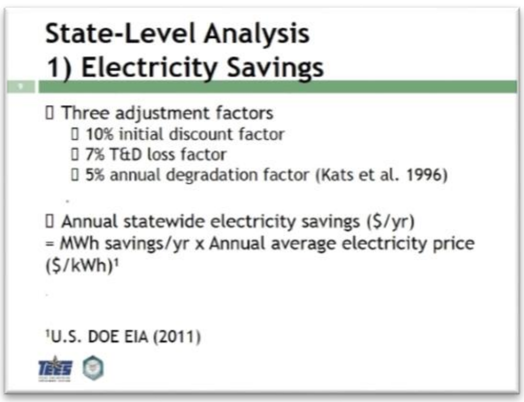
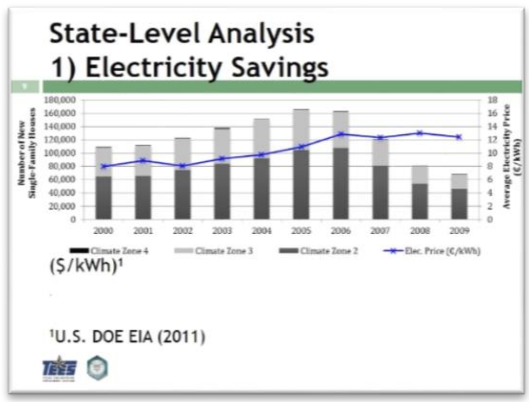


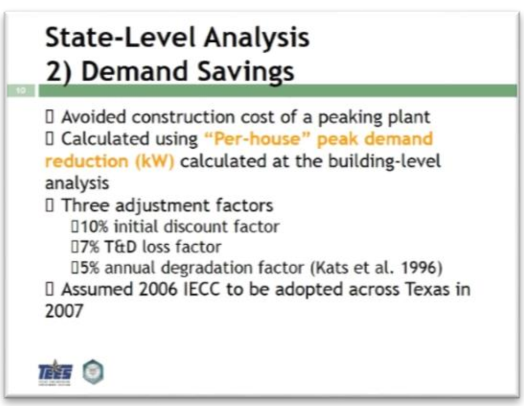
Figure 40: Presentation –TERP Stakeholder's Meeting, August 2012 (Continued)











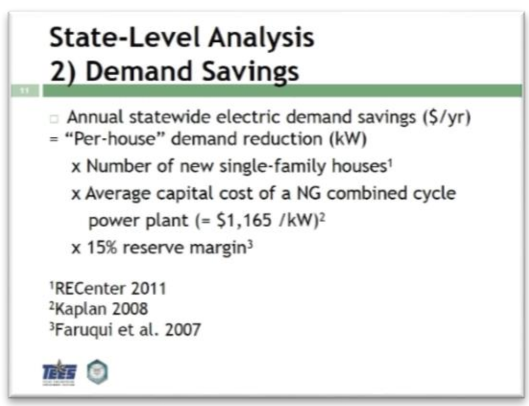


Figure 40: Presentation –TERP Stakeholder's Meeting, August 2012 (Continued)

Incremental Cost Analysis

12

- Increased costs for upgrading major residential building components and systems to comply with the 2001 IECC and the 2006 IECC
- Sources
  - R.S. Means Residential Cost Data
  - Building Codes Assistance Project (BCAP) Incremental Construction Cost Analysis for New Homes
  - ACEEE Consumer Guide to Home Energy Savings
  - Other individual studies conducted by the Laboratory (Malhotra et al. 2008; Kim et al. 2010)

Incremental Cost Analysis

13

- Annual increased construction costs ($/yr)
  = "Per-house" increased costs
  x Number of new single-family houses[1]

[1]RECenter 2011

BASE-CASE BUILDING

14

Energy Systems Laboratory 7/11/2012

Building Envelope

15

- 2,325 ft², square-shape, one story, single-family detached house
- Vented, unconditioned attic
- Light weight wood frame construction
- 18% window-to-floor ratio (27.1% window-to-wall ratio)

Building Envelope

16

- Other envelope characteristics as specified in
  - NAHB survey for 1999 construction in TX for pre-code
  - 2001 and 2006 IECC Chapter 4

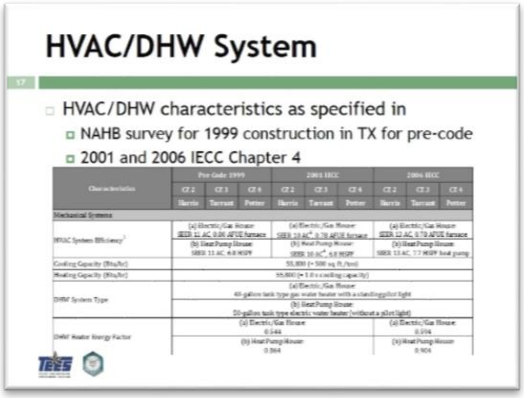
Building Envelope

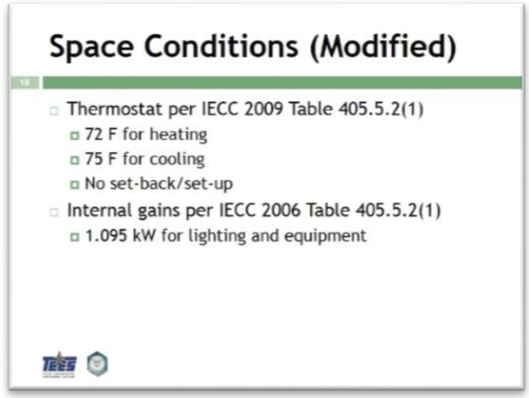
16

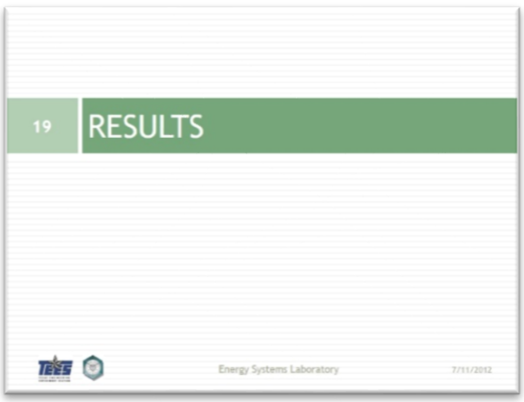
- Other envelope characteristics as specified in
  - NAHB survey for 1999 construction in TX for pre-code
  - 2001 and 2006 IECC Chapter 4

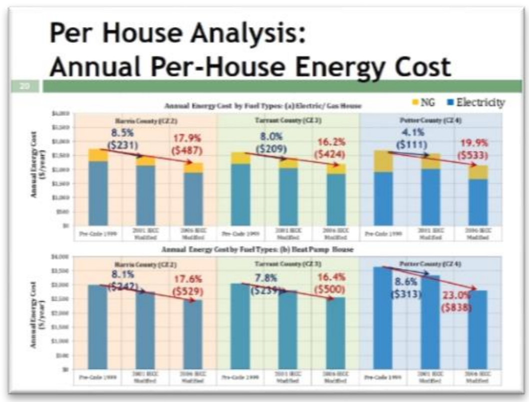
Characteristics	Pre-Code 1999			2001 IECC			2006 IECC		
	CZ 2	CZ 3	CZ 4	CZ 2	CZ 3	CZ 4	CZ 2	CZ 3	CZ 4
	Harris	Tarrant	Potter	Harris	Tarrant	Potter	Harris	Tarrant	Potter
Construction									
Ceiling Insulation (hr-sq.ft-°F/Btu)	R-27.08	R-26.75		R-30	R-38		R-27.84		R-32.51
Wall Insulation (hr-sq.ft-°F/Btu)	R-12.99	R-14.10		R-11		R-12/2 ci	R-11.0		
Slab Perimeter Insulation	None		R-6	None		R-6	None		R-10
U-Factor of Glazing (Btu/hr-sq.ft-°F)	1.11	0.87		0.47		0.41	0.75	0.65	0.40
Solar Heat Gain Coefficient (SHGC)	0.71	0.66		0.40		0.68	0.40		
Exterior Shading	None								
Roof Radiant Barrier	No								

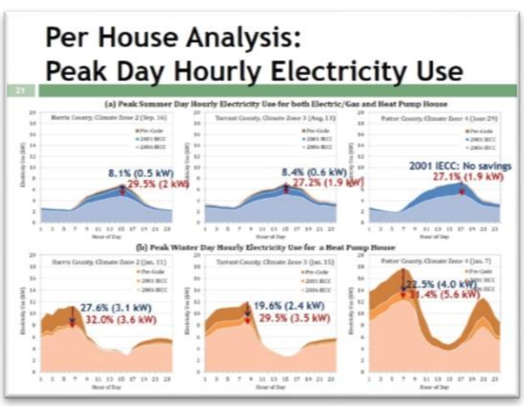
Figure 40: Presentation –TERP Stakeholder's Meeting, August 2012 (Continued)











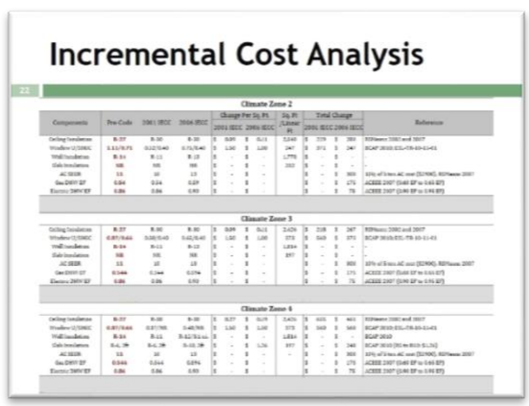
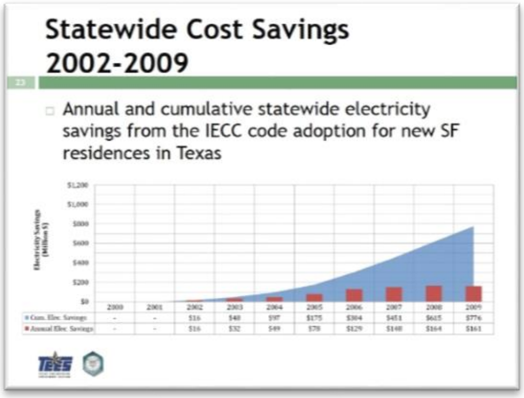
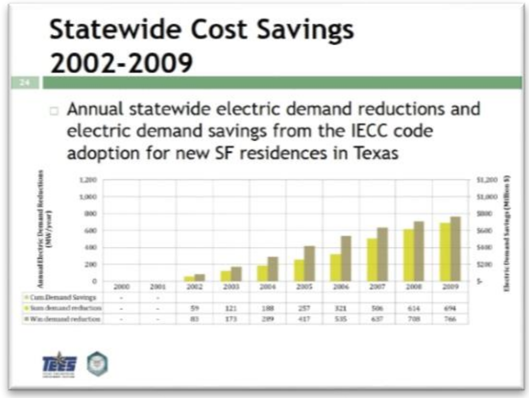
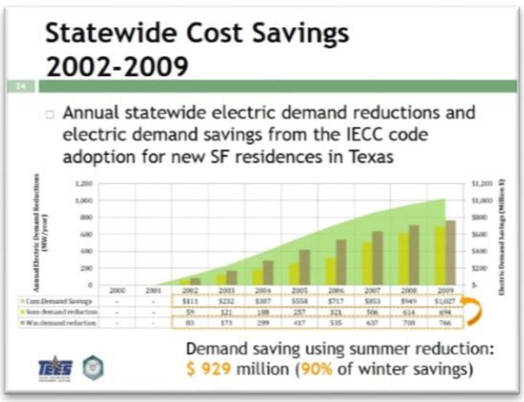


Figure 40: Presentation –TERP Stakeholder's Meeting, August 2012 (Continued)







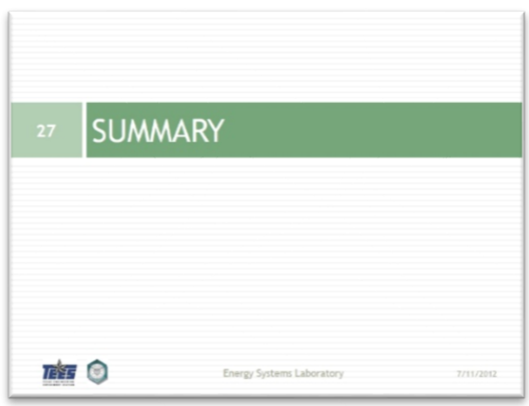
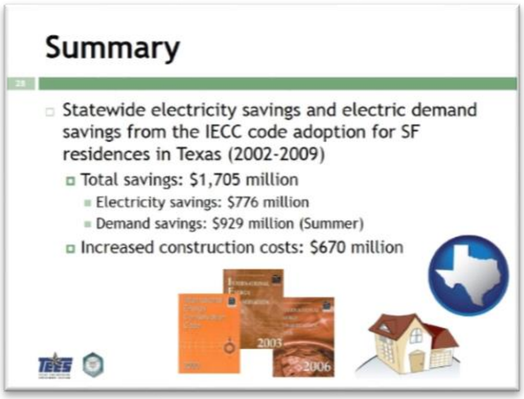


Figure 40: Presentation –TERP Stakeholder’s Meeting, August 2012 (Continued)



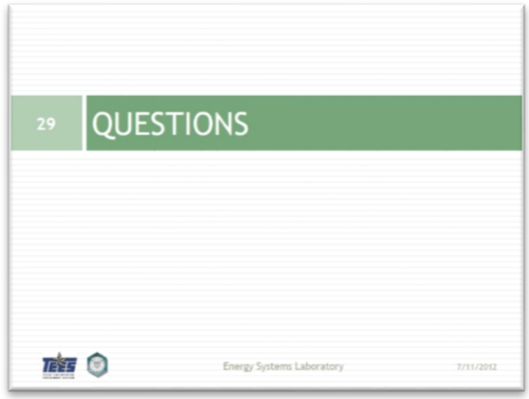
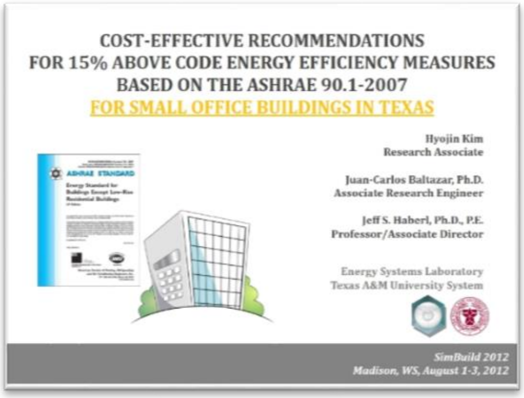
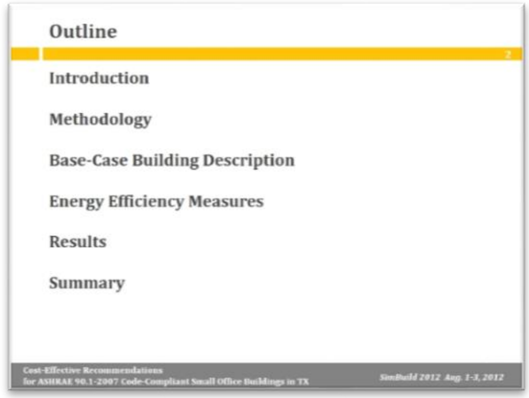
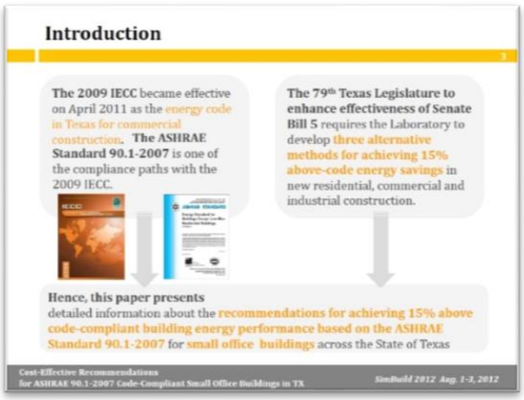


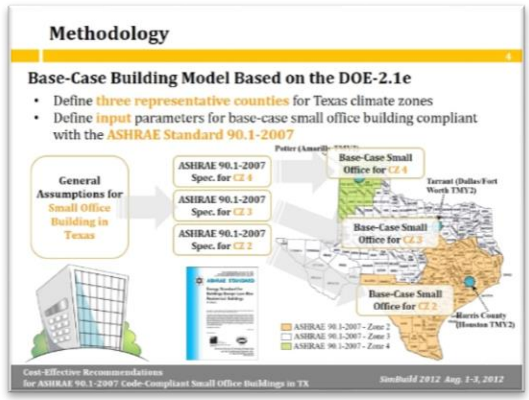
Figure 40: Presentation –TERP Stakeholder’s Meeting, August 2012 (Continued)

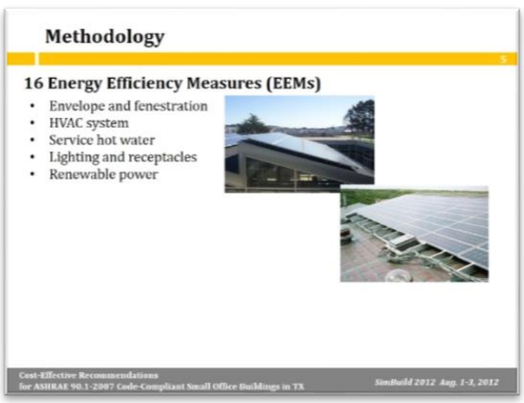
Presentation to IBPSA, August 2012











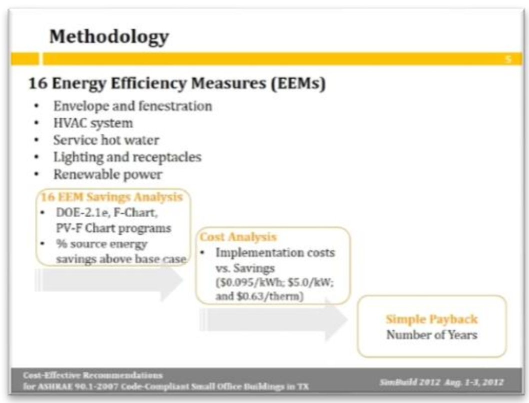
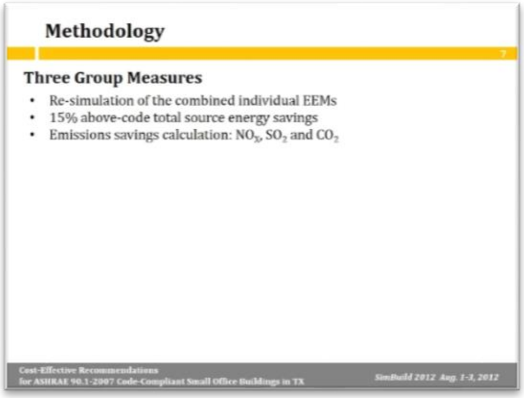
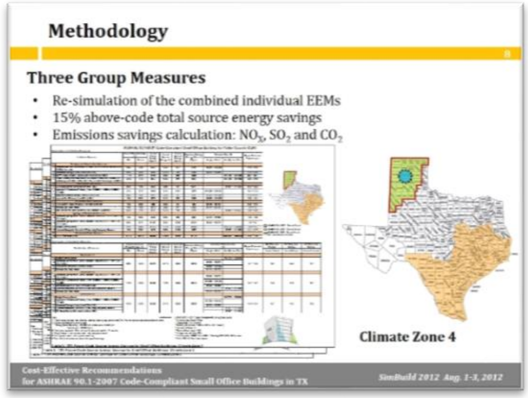
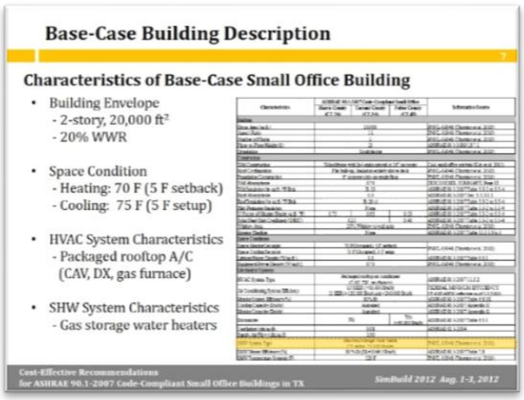
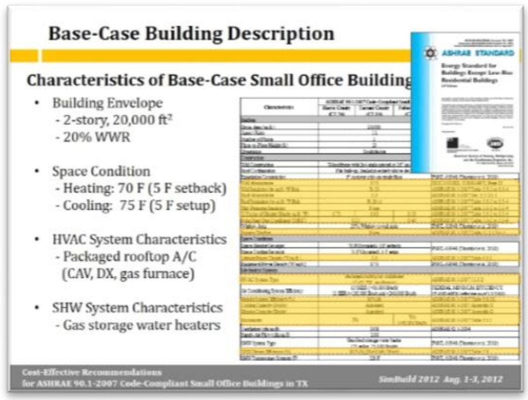


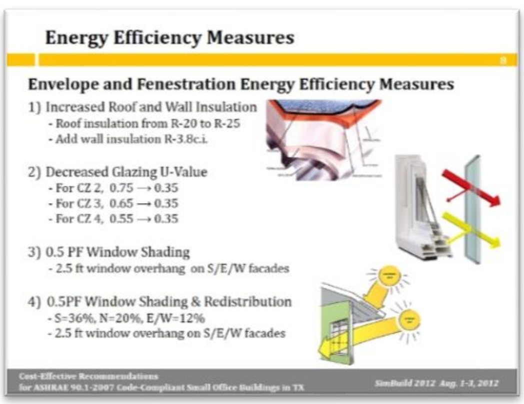
Figure 41: Presentation to IBPSA, August 2012











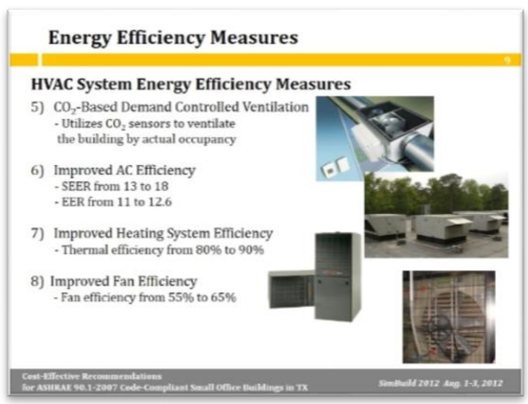
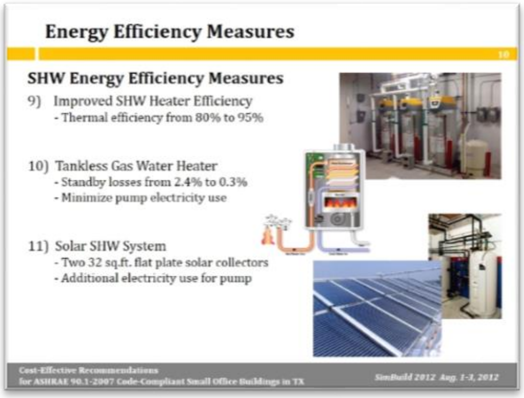
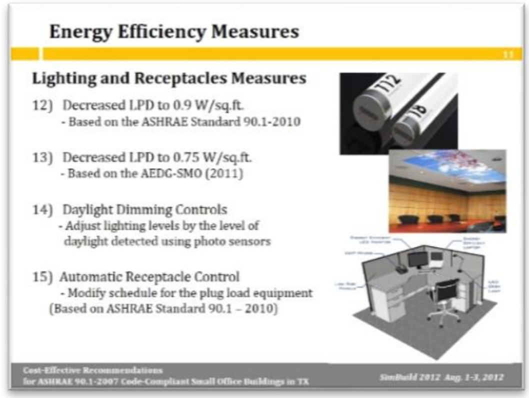
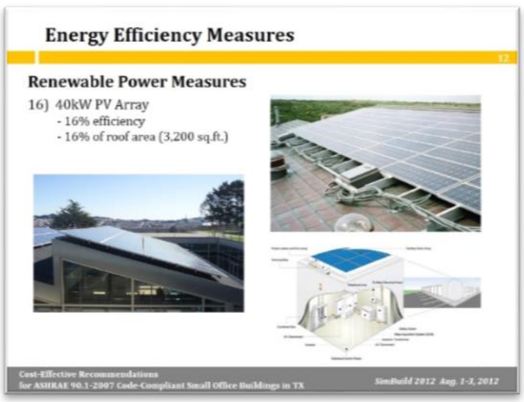
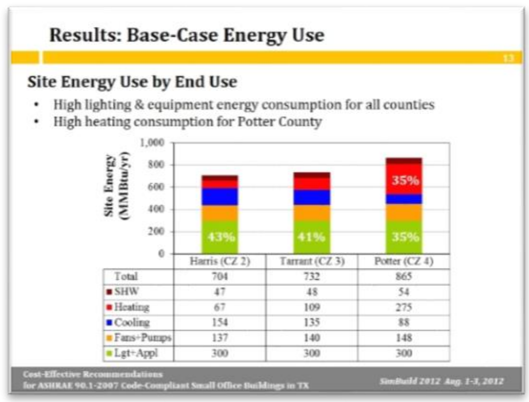


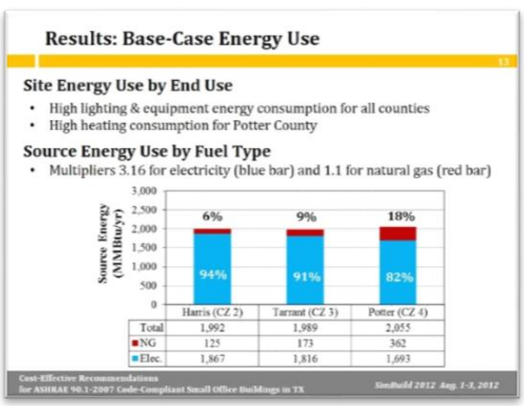
Figure 41: Presentation to IBPSA, August 2012 (continued)











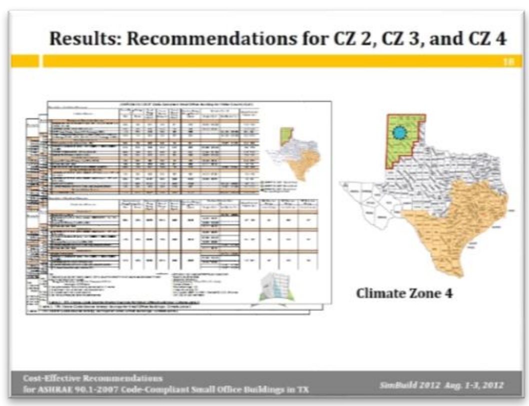
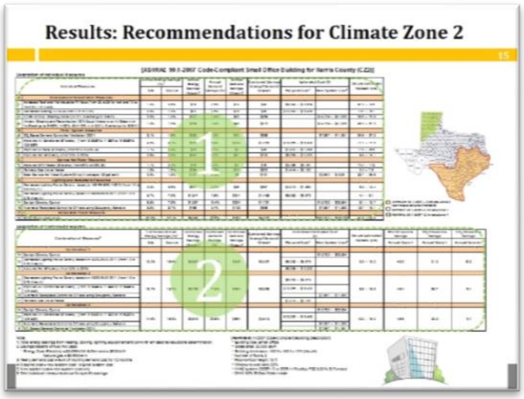
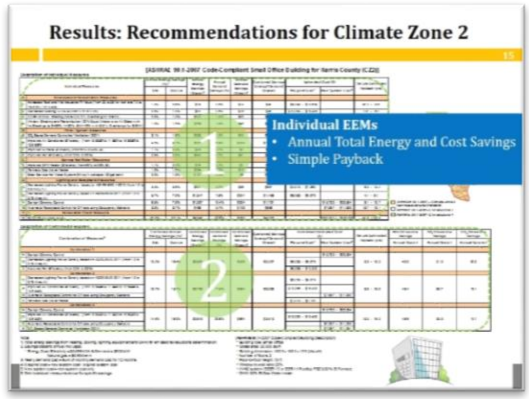
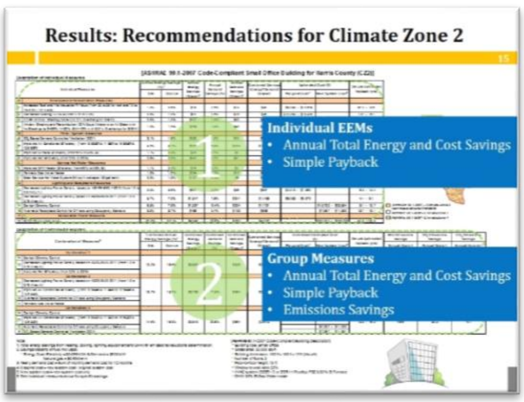
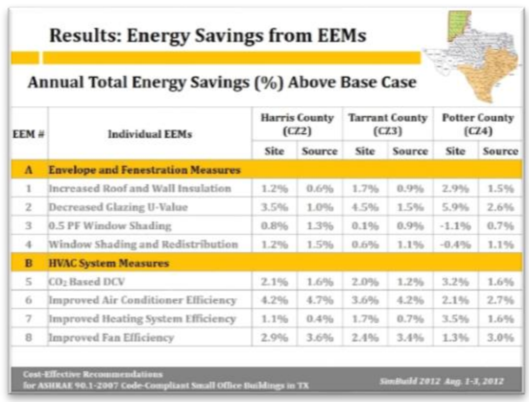


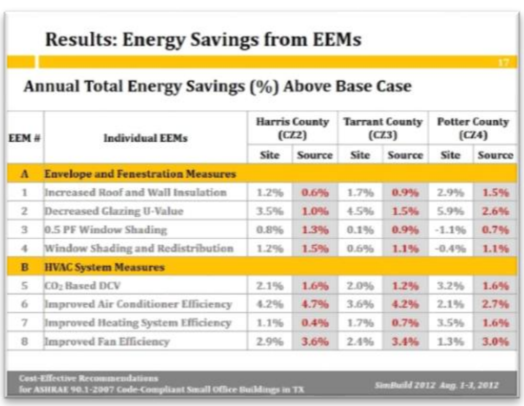
Figure 41: Presentation to IBPSA, August 2012 (continued)











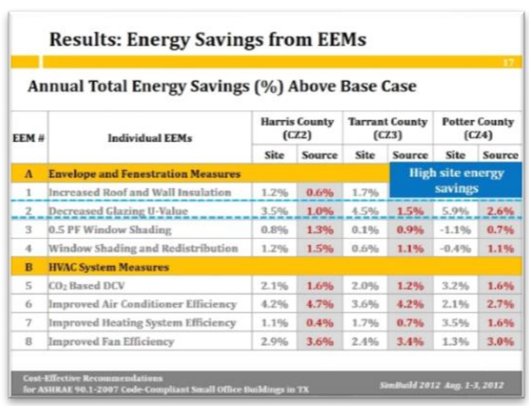
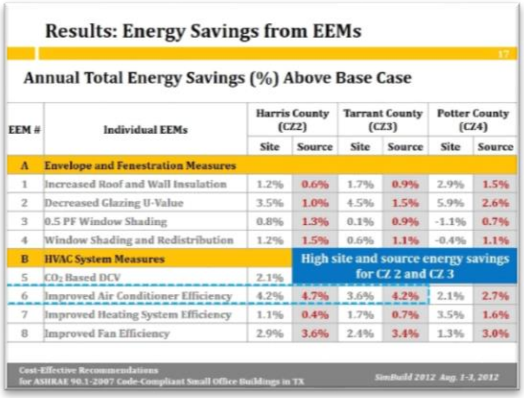
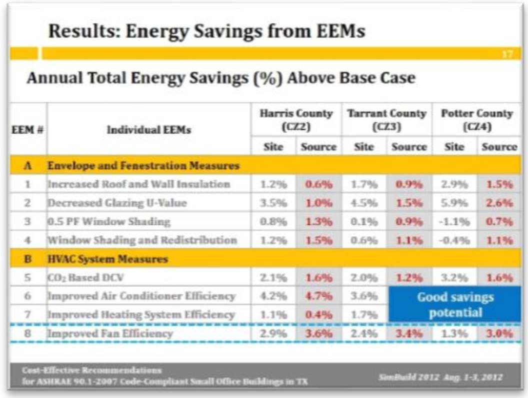
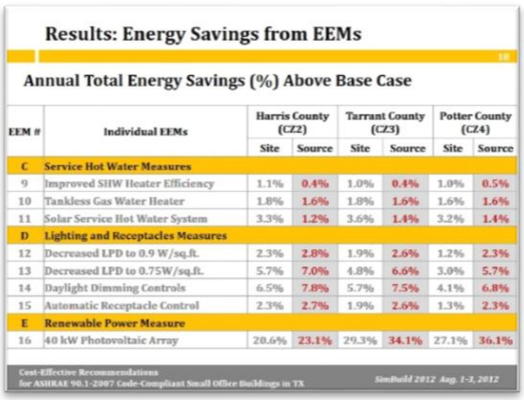
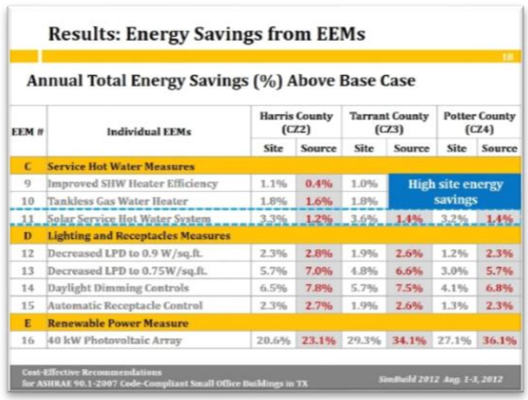


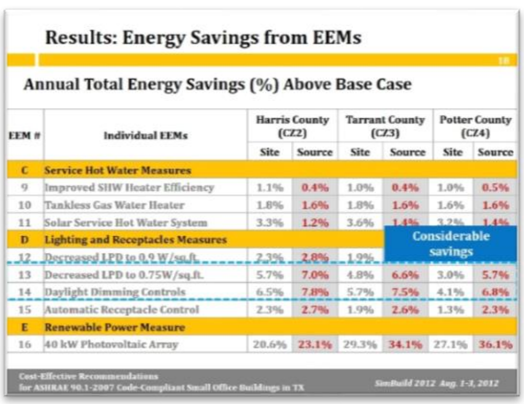
Figure 41: Presentation to IBPSA, August 2012 (continued)











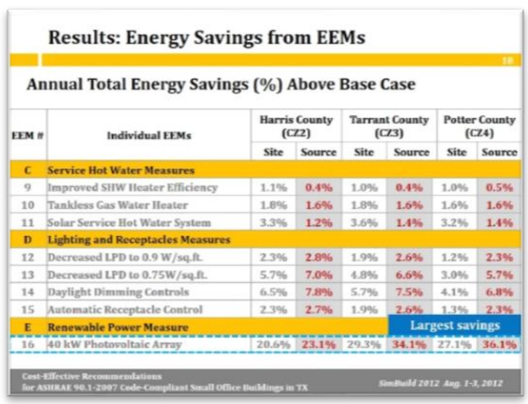
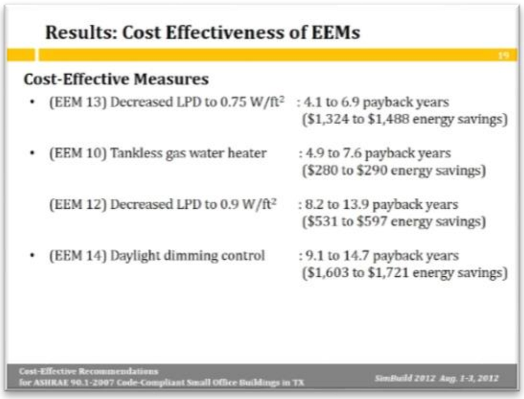
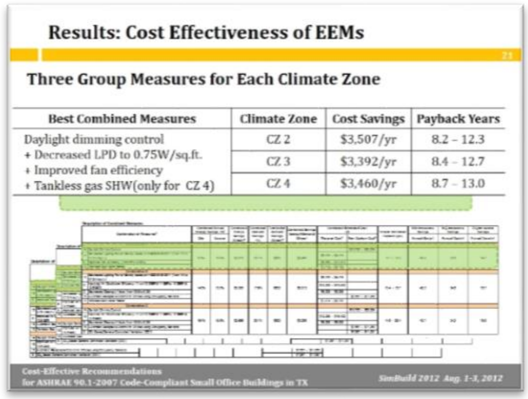
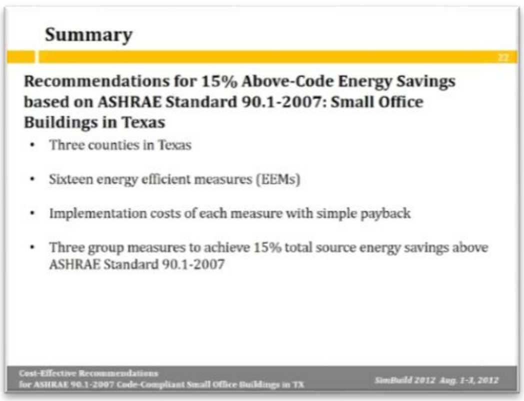
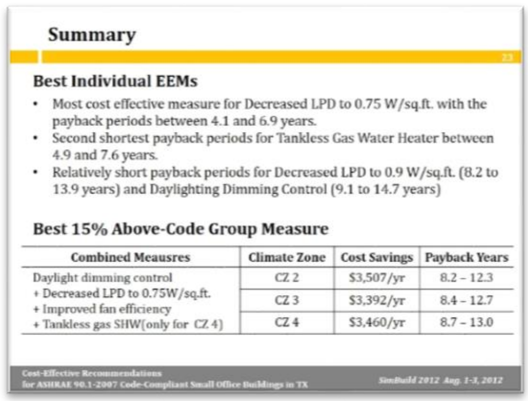


Figure 41: Presentation to IBPSA, August 2012 (continued)









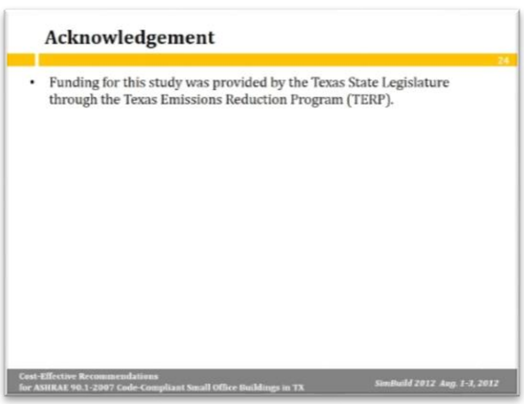
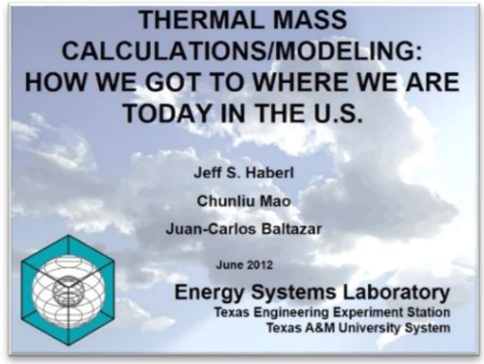
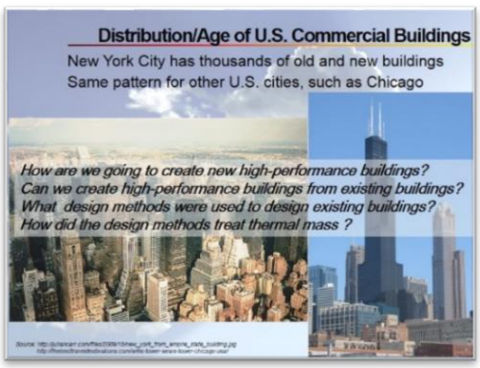
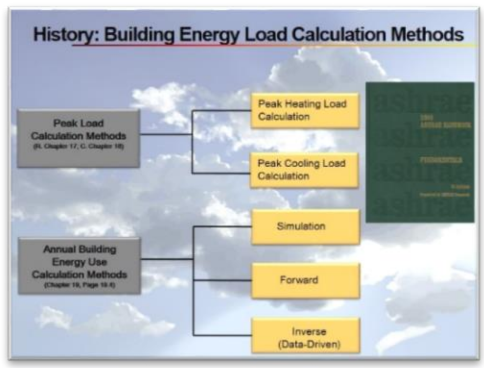
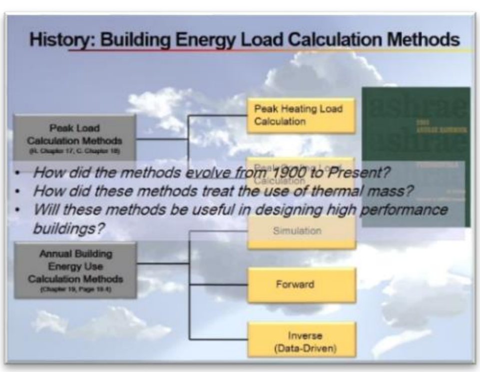


Figure 41: Presentation to IBPSA, August 2012 (continued)









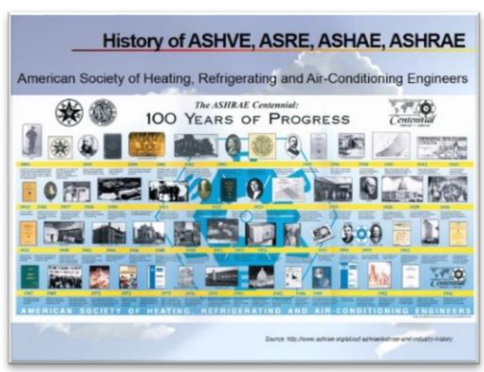
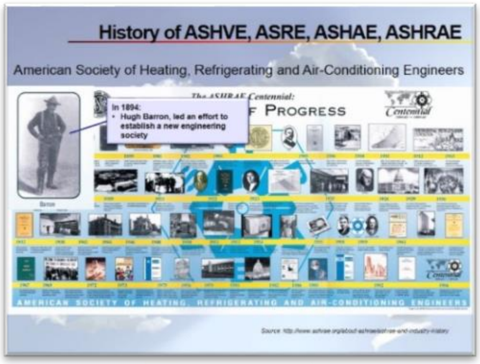
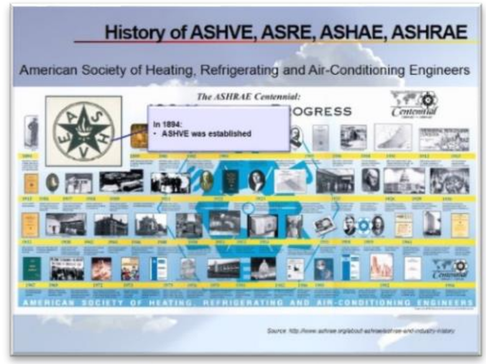
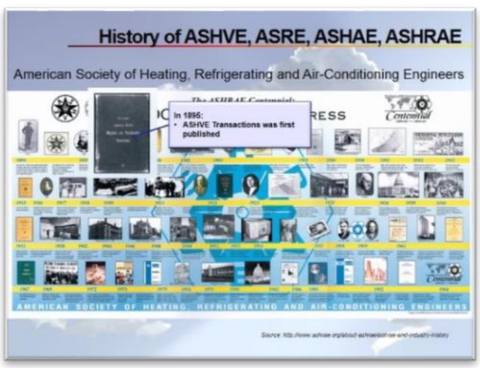
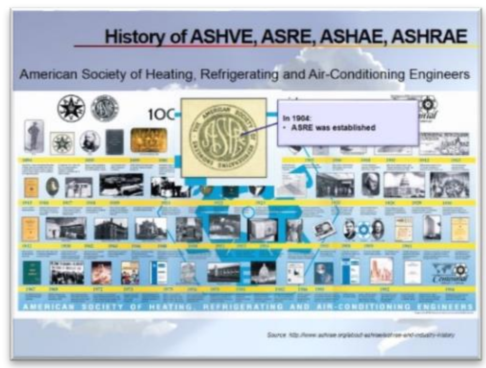


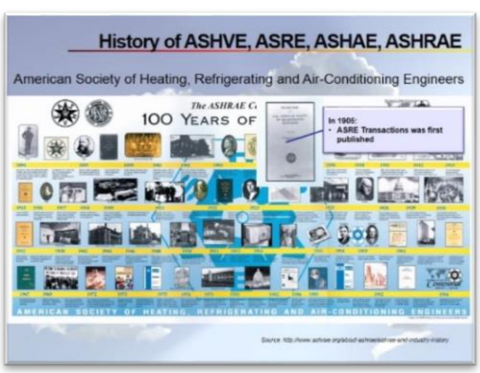
Figure 41: Presentation to IBPSA, August 2012 (continued)











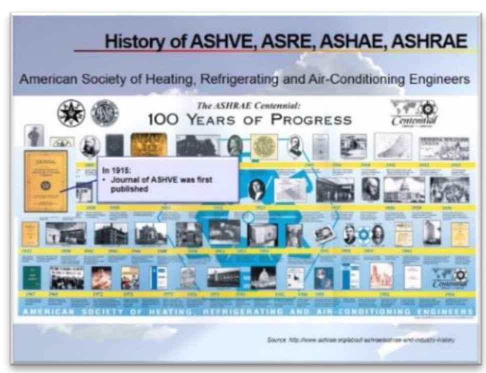
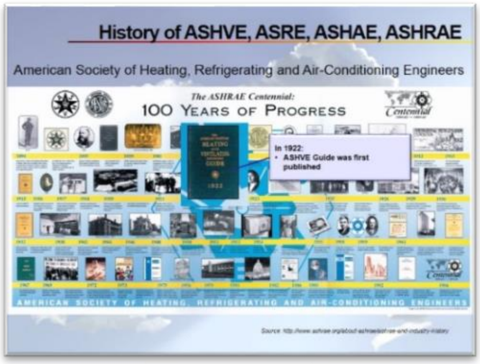
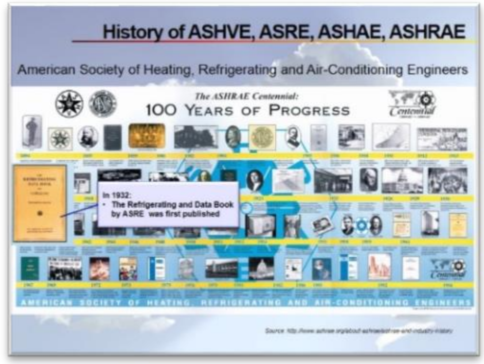
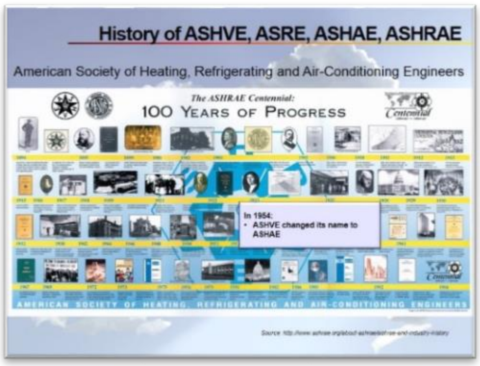
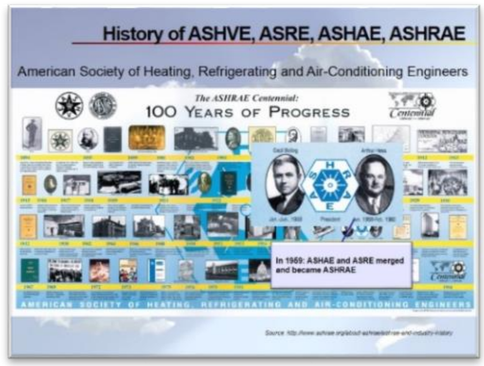


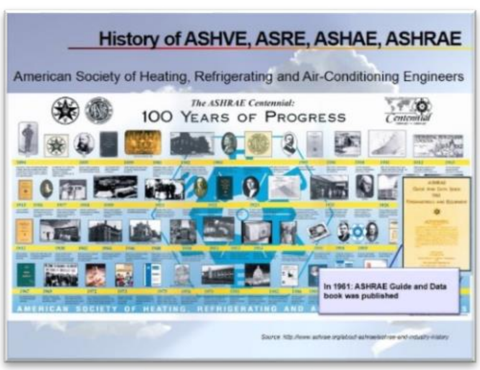
Figure 41: Presentation to IBPSA, August 2012 (continued)











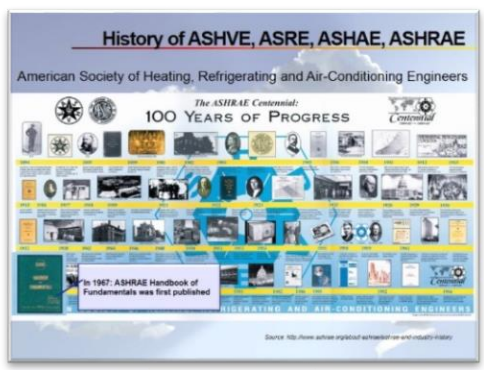
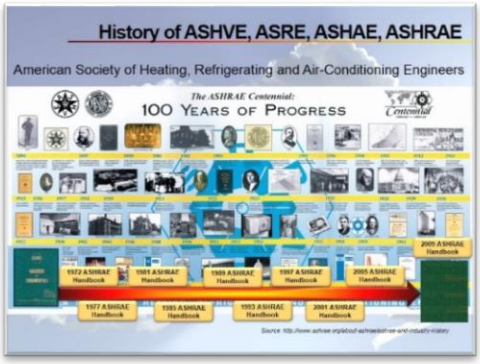
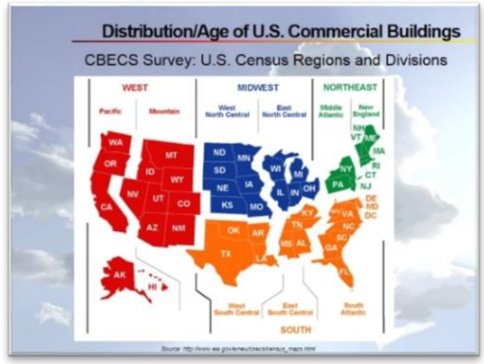
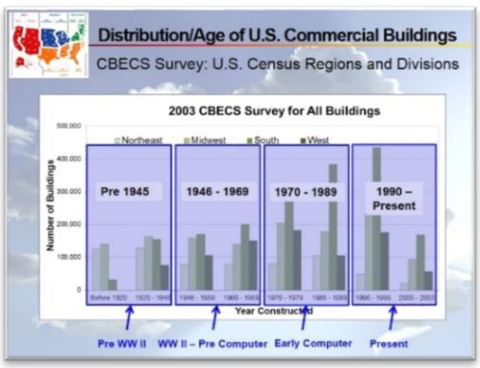
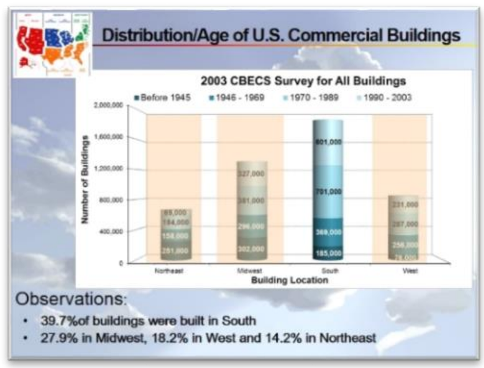


Figure 41: Presentation to IBPSA, August 2012 (continued)









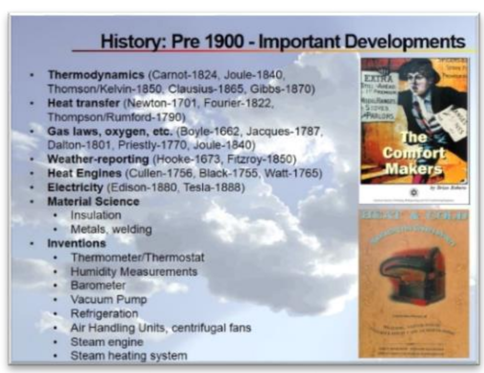
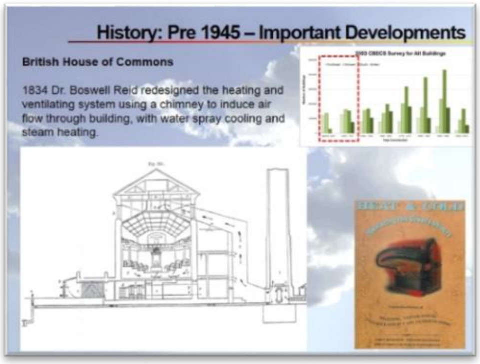
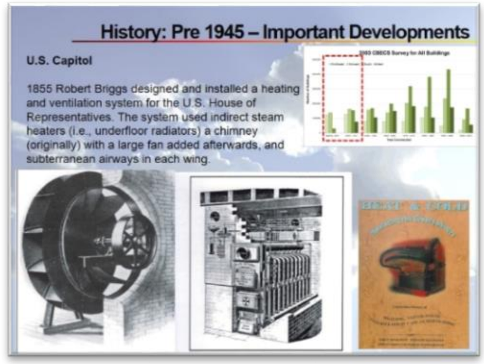
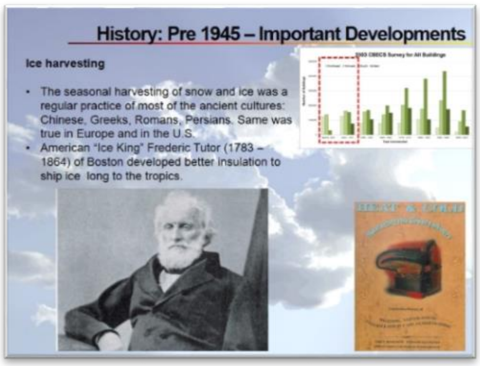
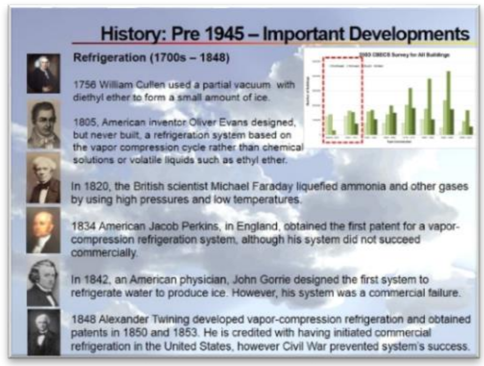


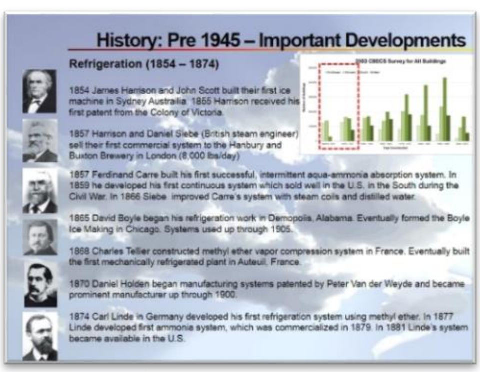
Figure 41: Presentation to IBPSA, August 2012 (continued)











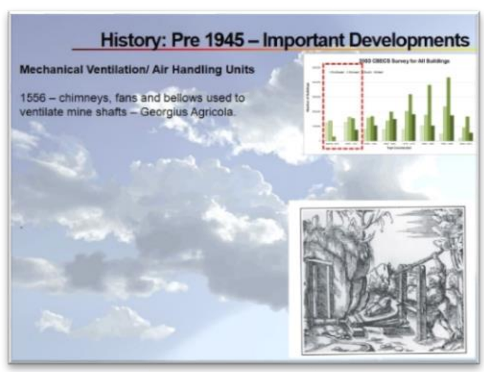
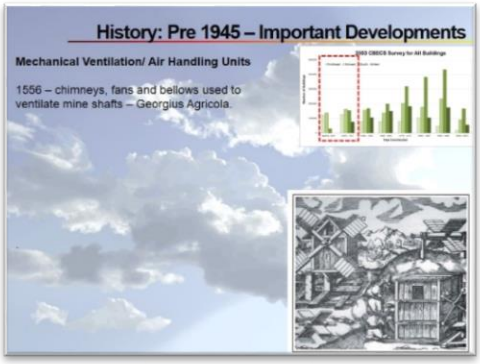
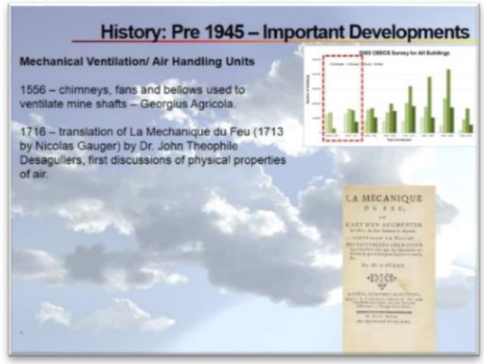
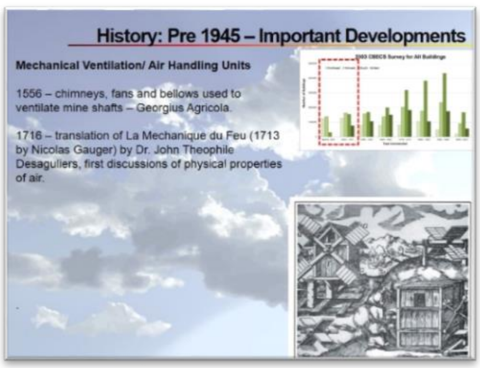
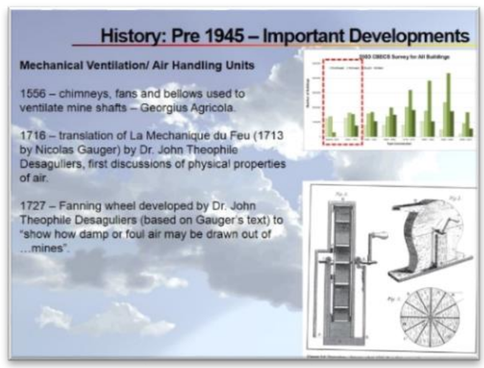


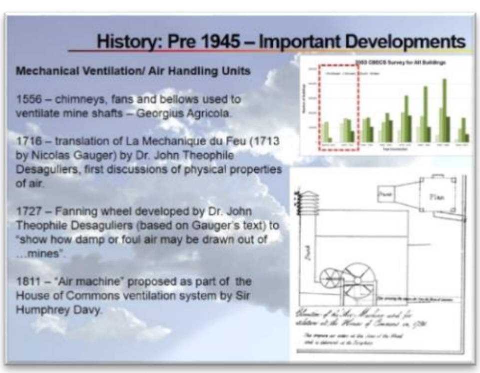
Figure 41: Presentation to IBPSA, August 2012 (continued)











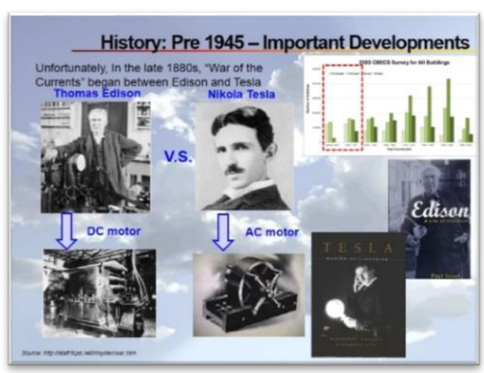
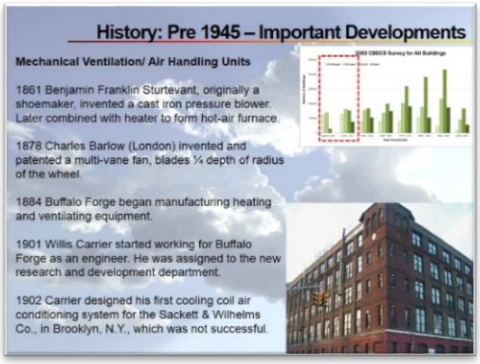
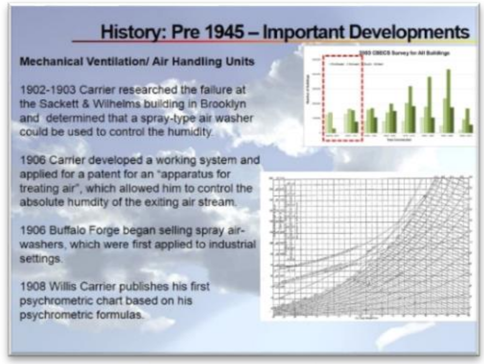
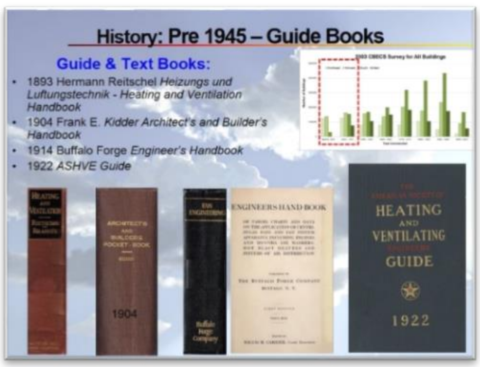
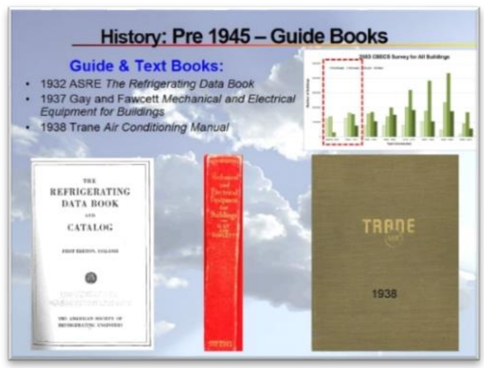


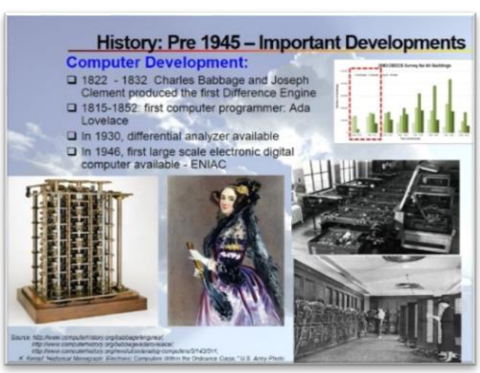
Figure 41: Presentation to IBPSA, August 2012 (continued)











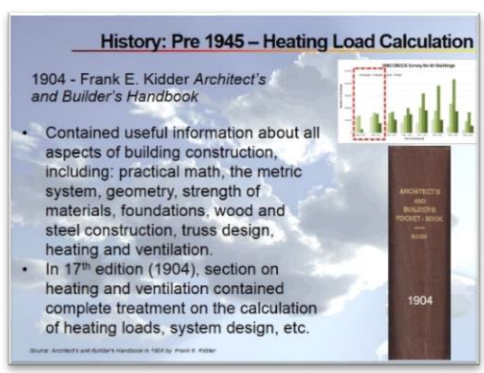
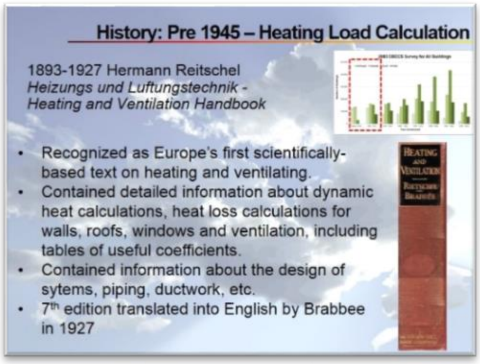
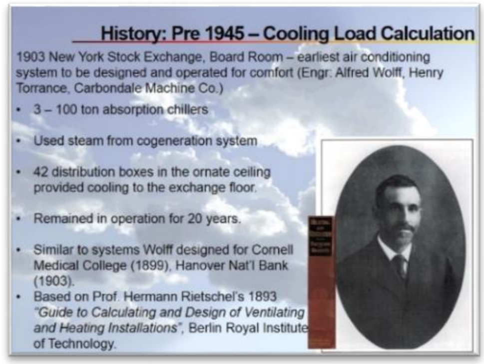
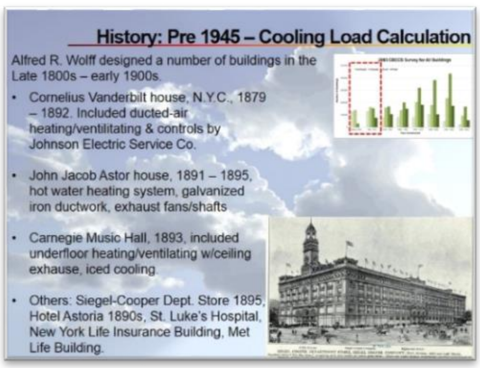
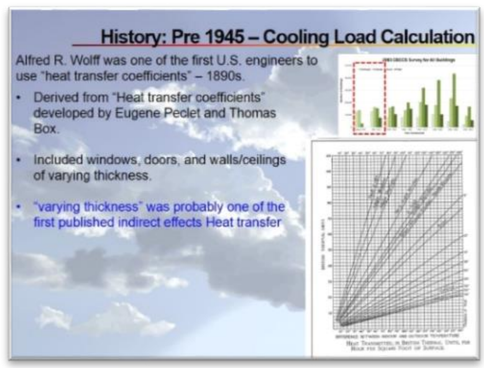


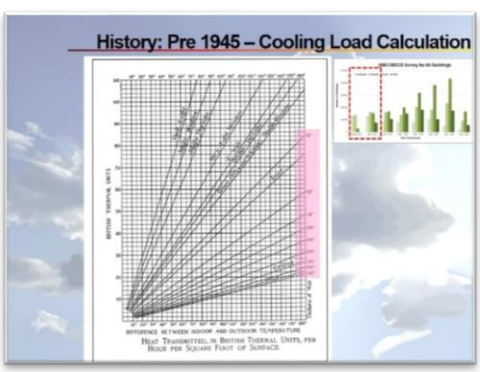
Figure 41: Presentation to IBPSA, August 2012 (continued)











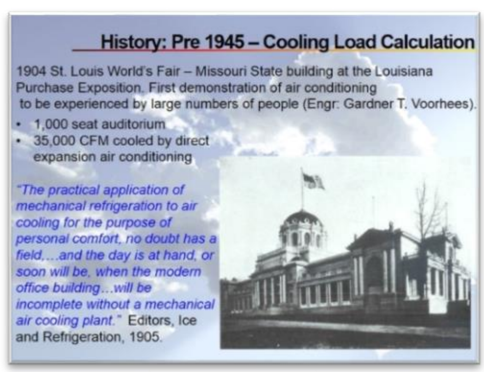
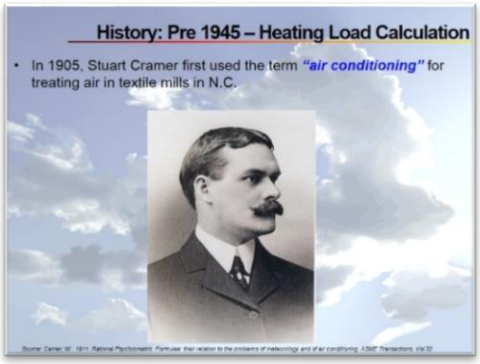
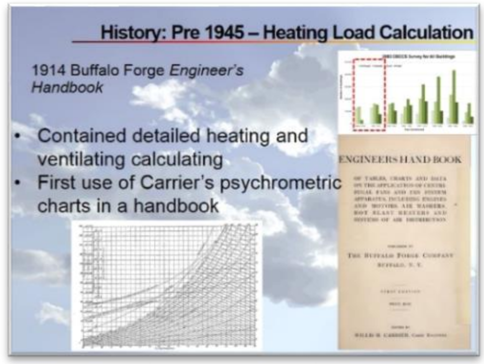
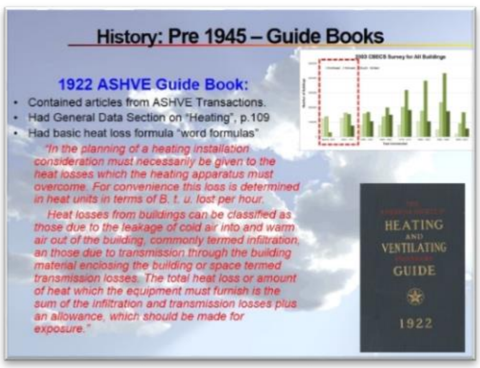
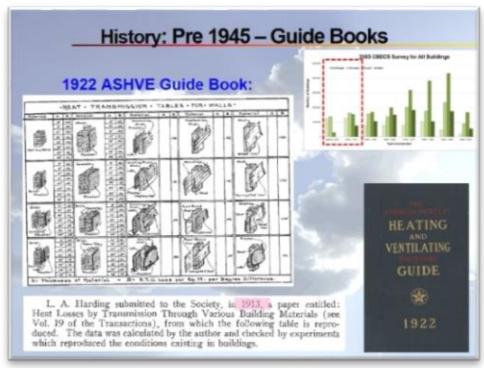


Figure 41: Presentation to IBPSA, August 2012 (continued)









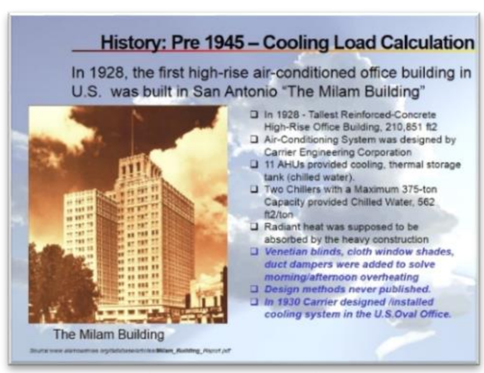
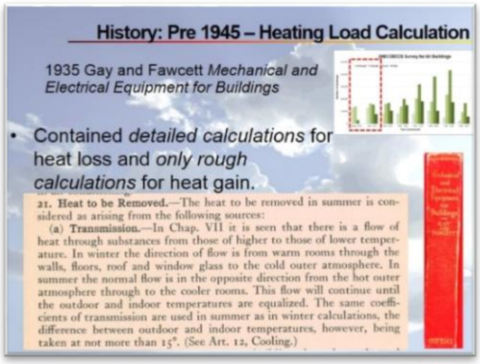
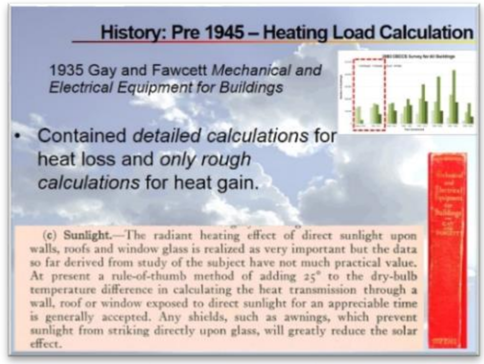
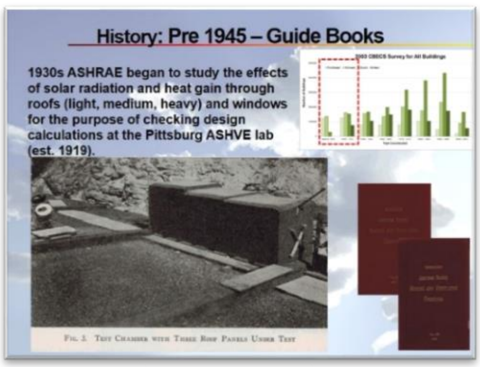
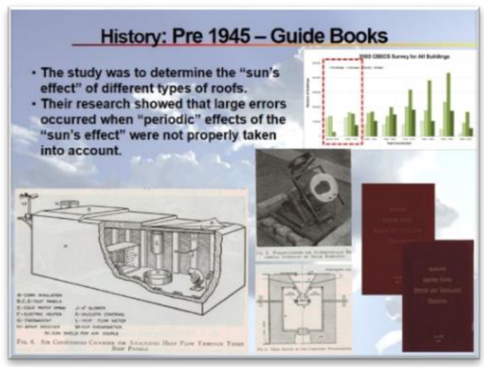


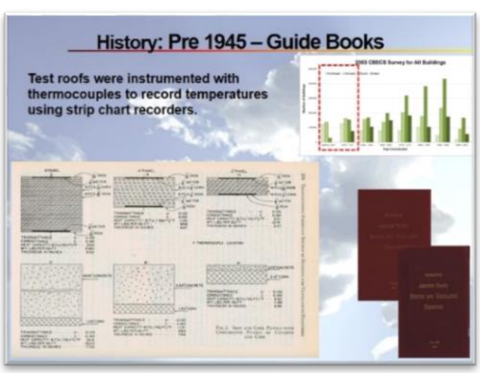
Figure 41: Presentation to IBPSA, August 2012 (continued)











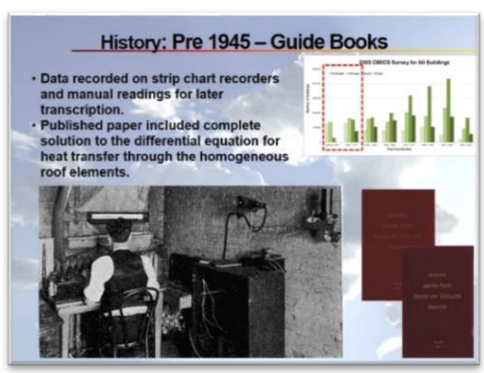
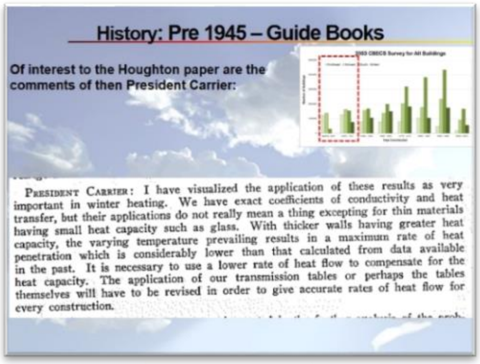
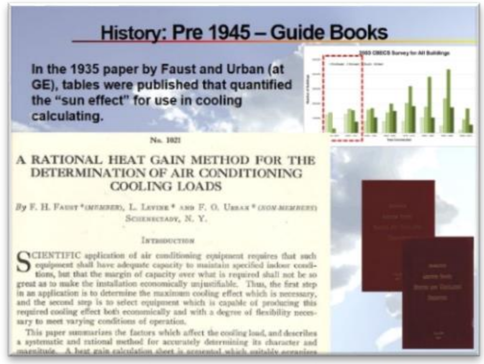
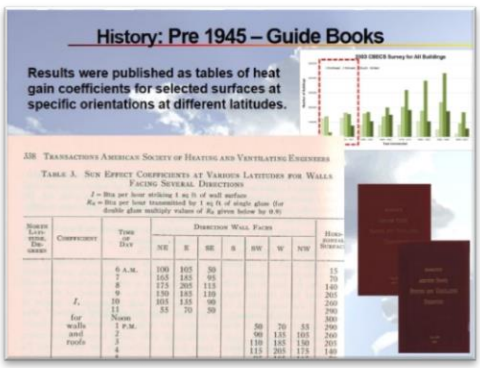
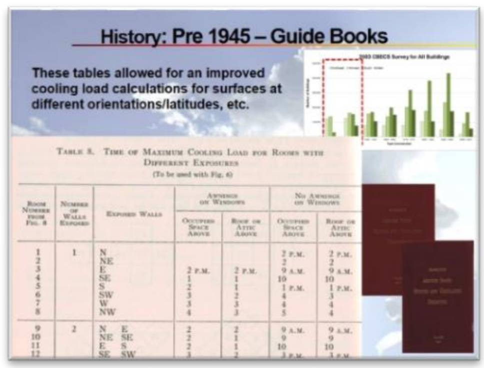


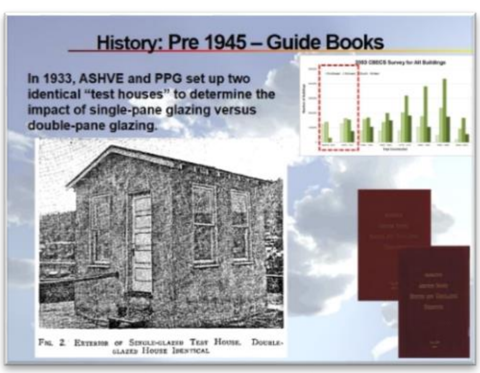
Figure 41: Presentation to IBPSA, August 2012 (continued)











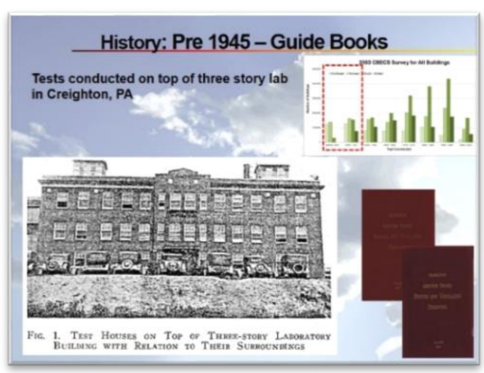
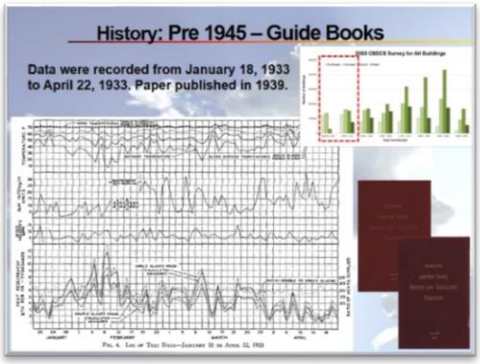
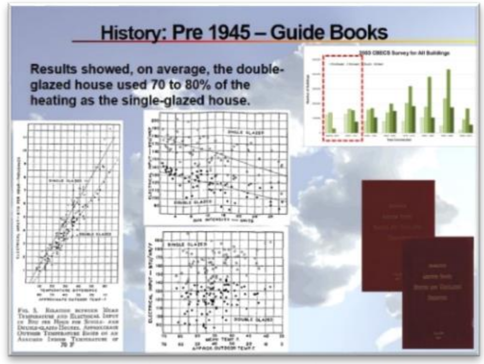
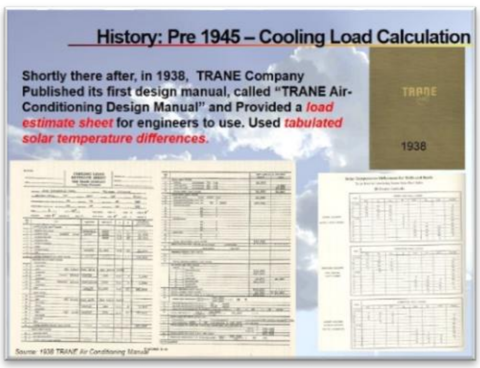
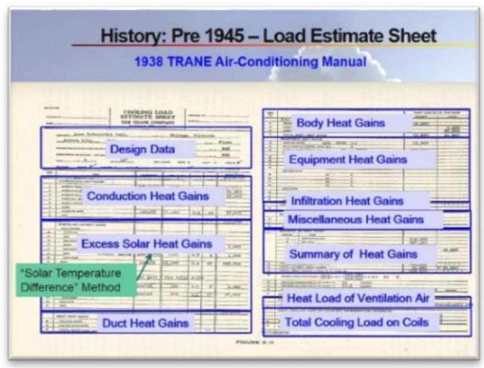


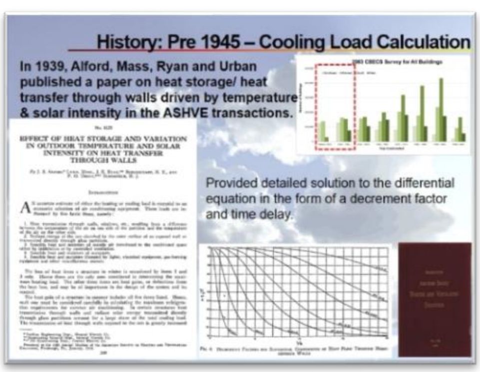
Figure 41: Presentation to IBPSA, August 2012 (continued)











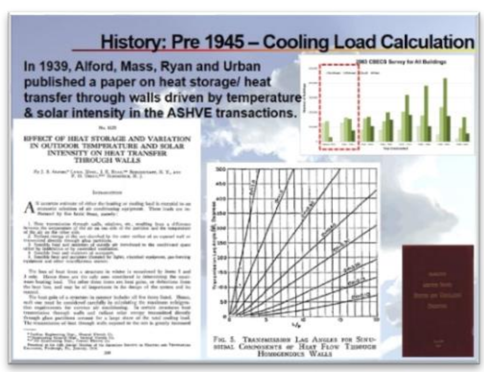
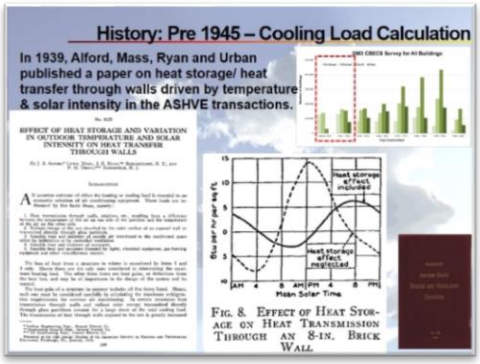
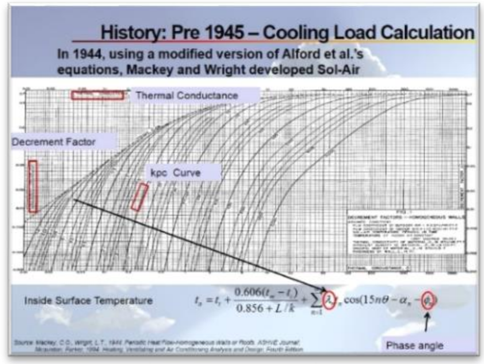
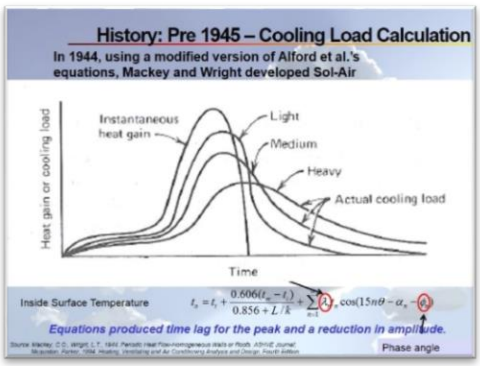
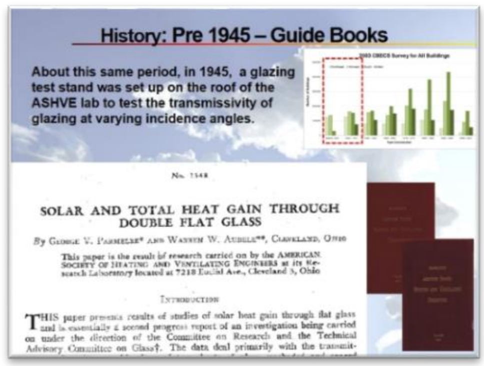


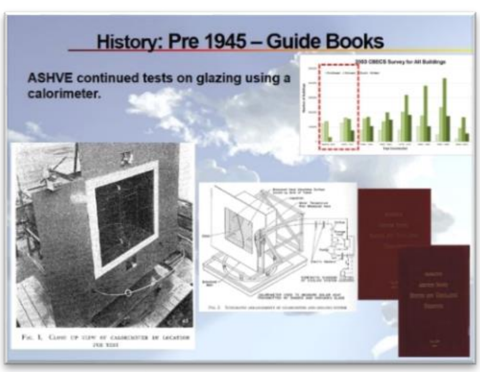
Figure 41: Presentation to IBPSA, August 2012 (continued)











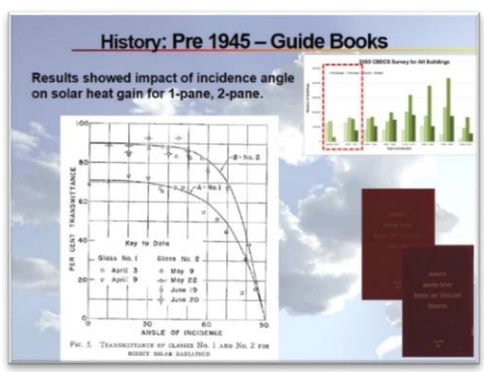
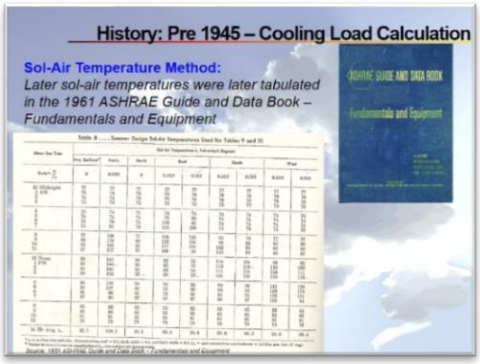
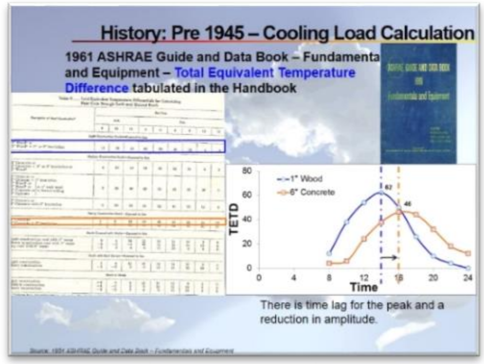
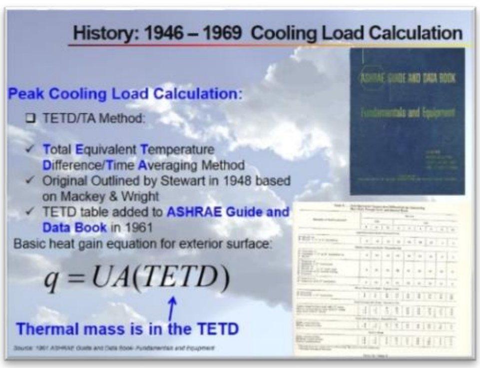
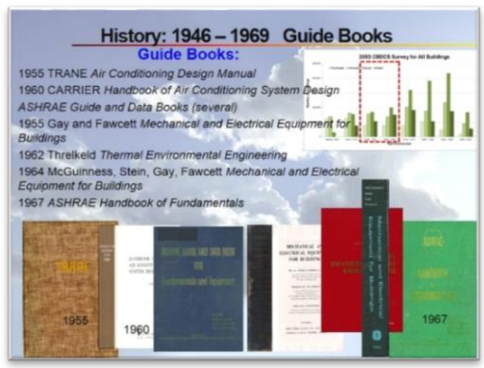


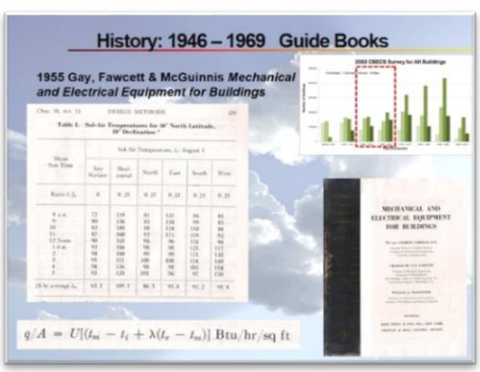
Figure 41: Presentation to IBPSA, August 2012 (continued)











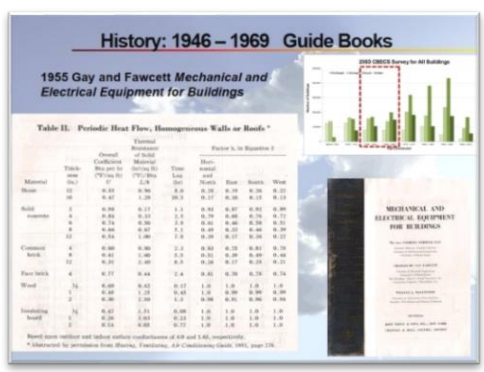
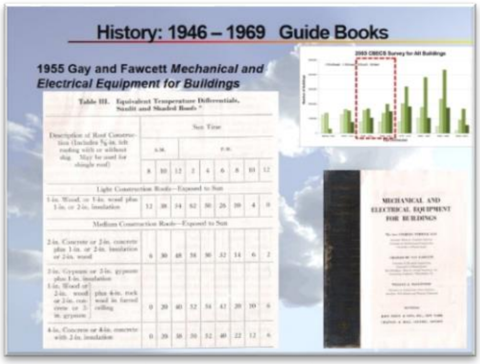
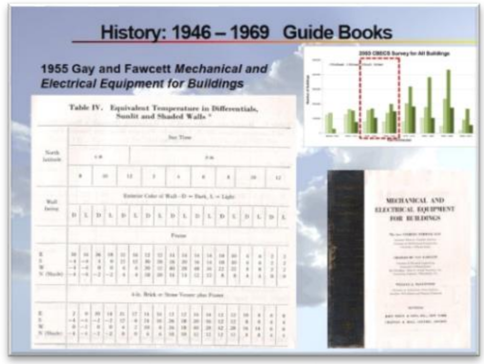
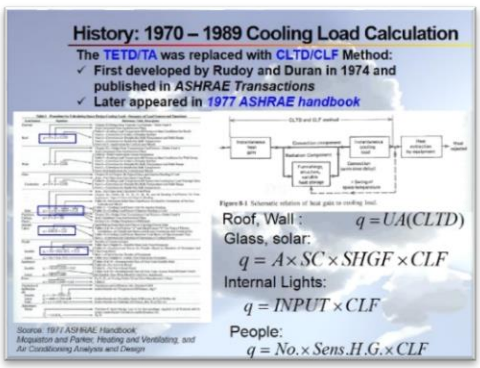
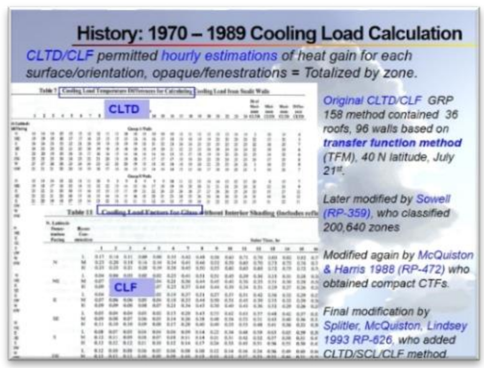


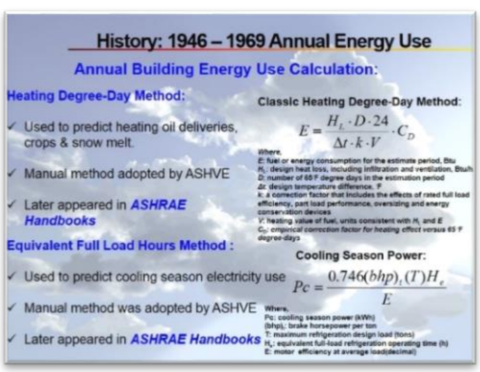
Figure 41: Presentation to IBPSA, August 2012 (continued)











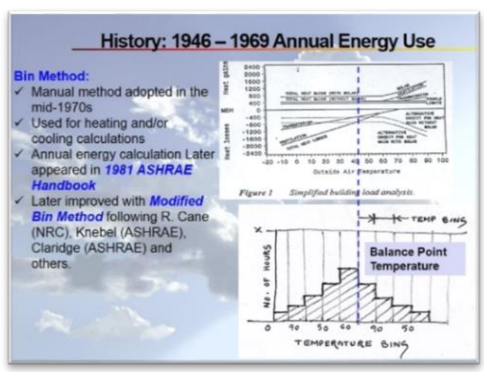
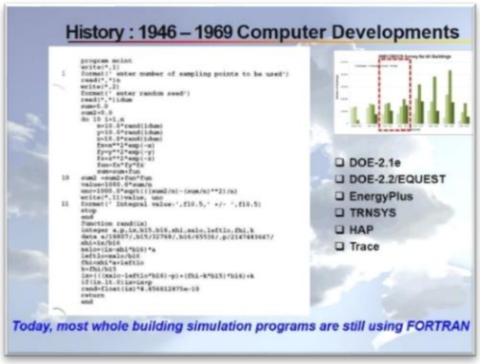
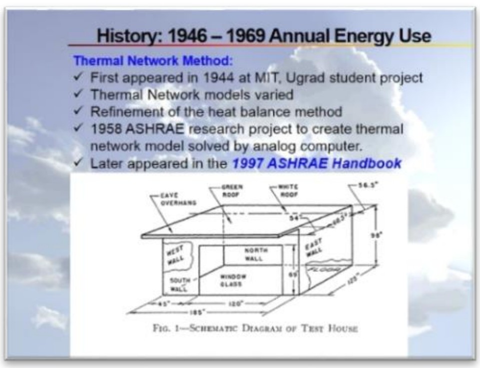
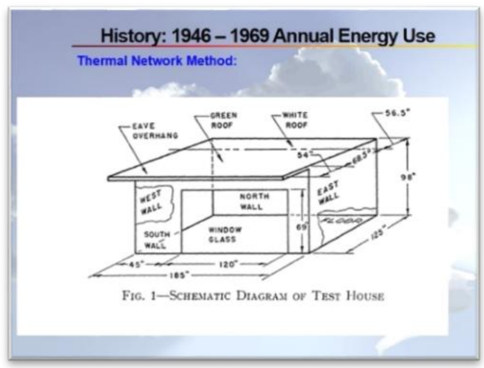
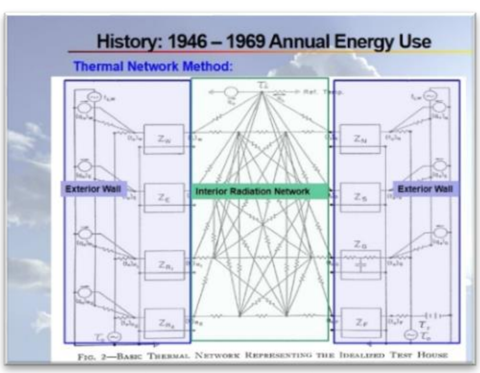


Figure 41: Presentation to IBPSA, August 2012 (continued)









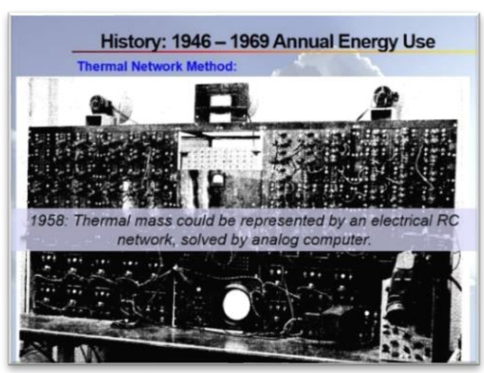
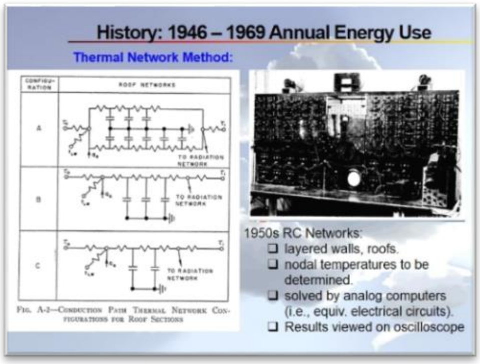
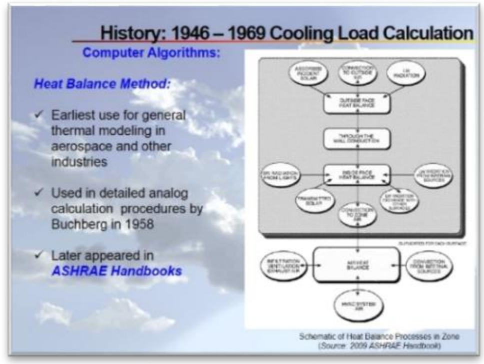
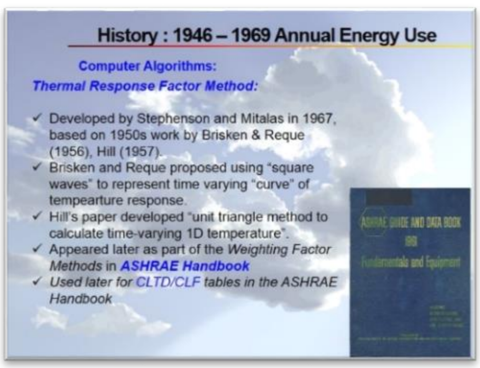
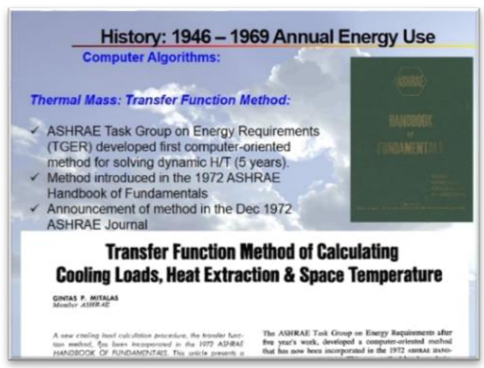


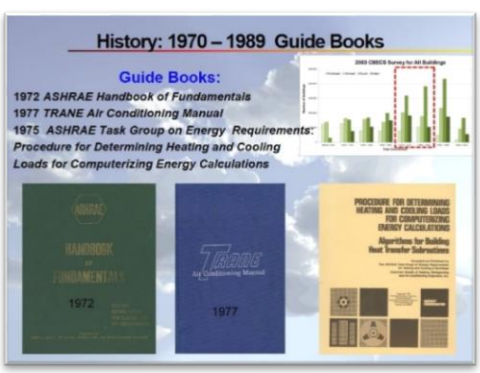
Figure 41: Presentation to IBPSA, August 2012 (continued)











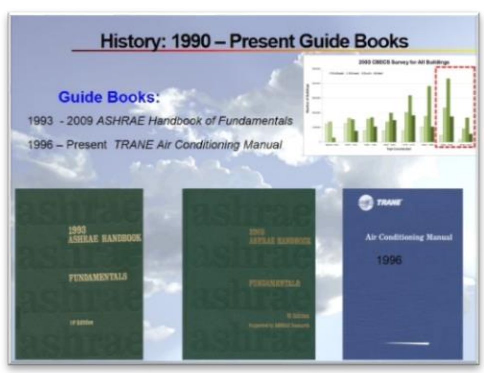
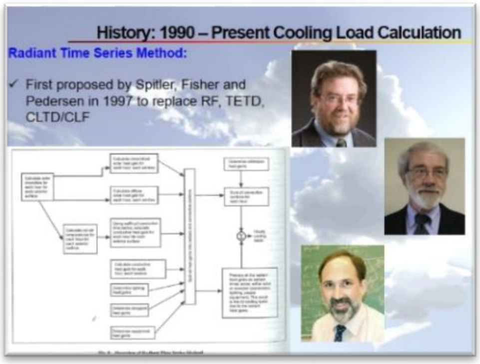
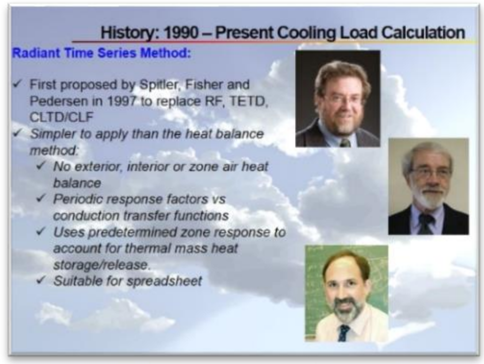
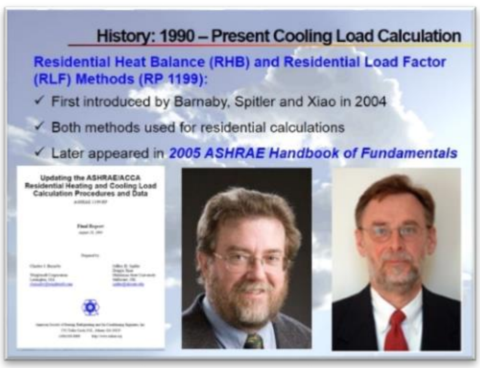
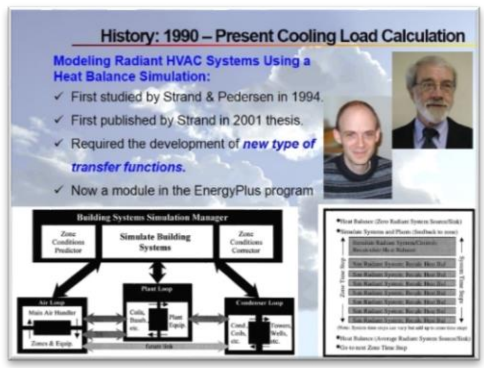


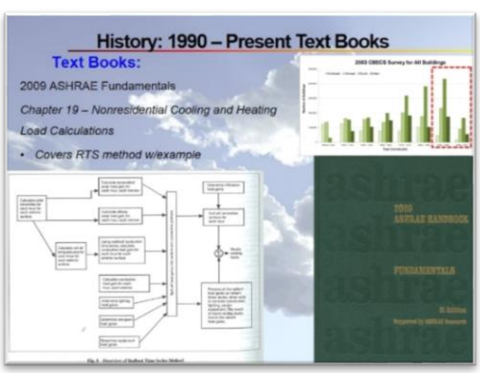
Figure 41: Presentation to IBPSA, August 2012 (continued)











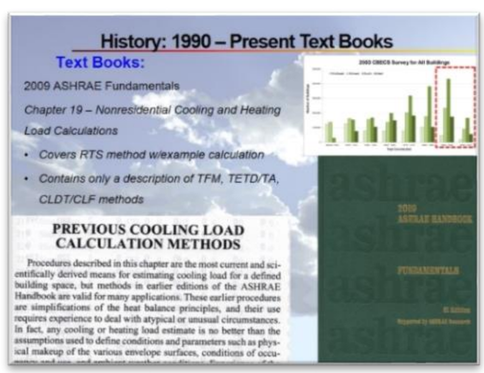
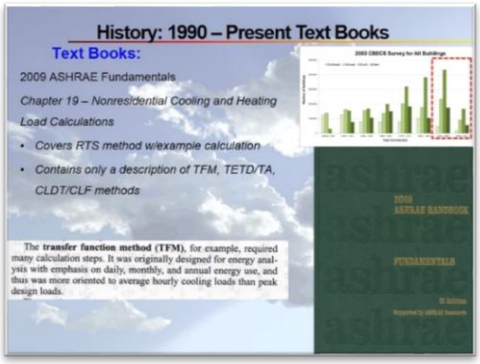
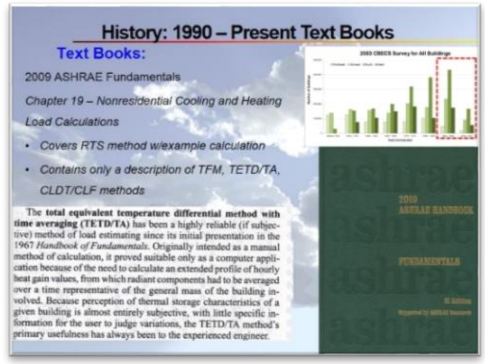
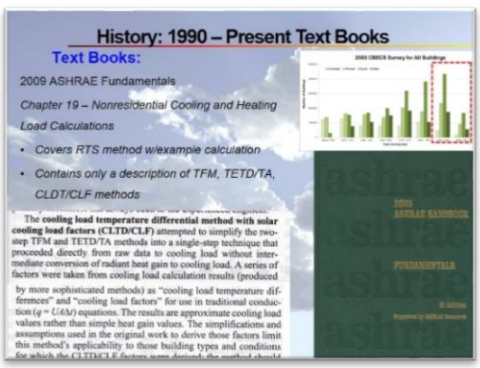
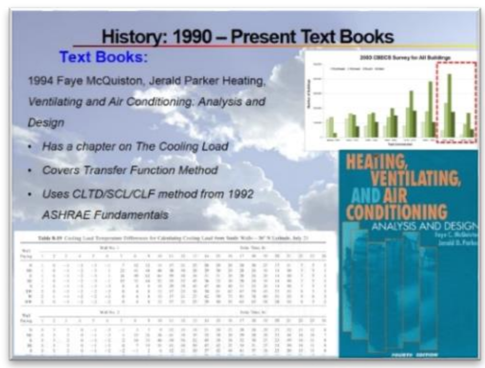


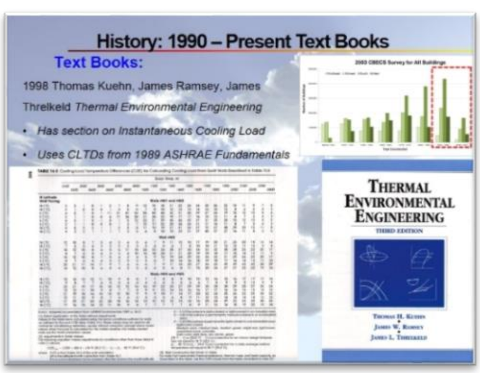
Figure 41: Presentation to IBPSA, August 2012 (continued)











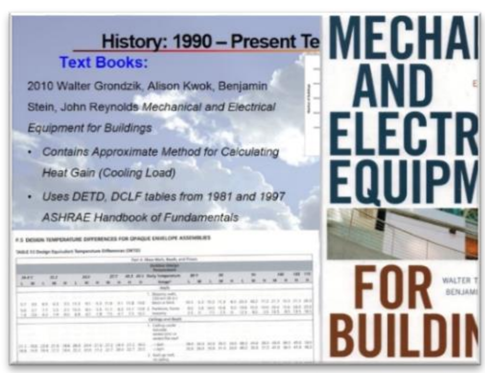
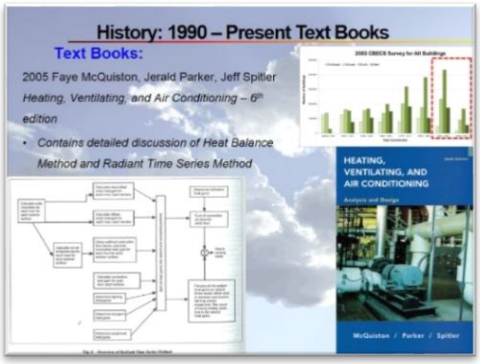
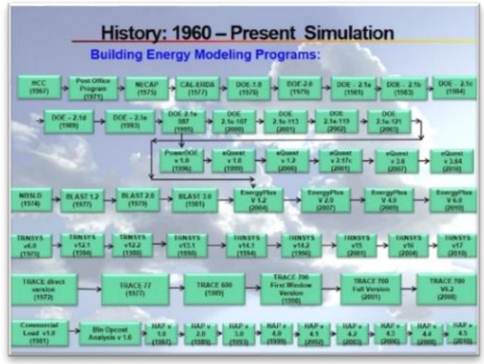
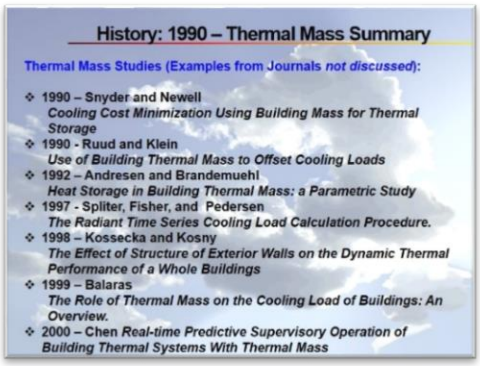
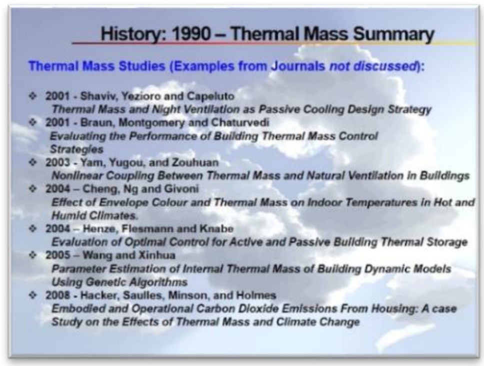


Figure 41: Presentation to IBPSA, August 2012 (continued)









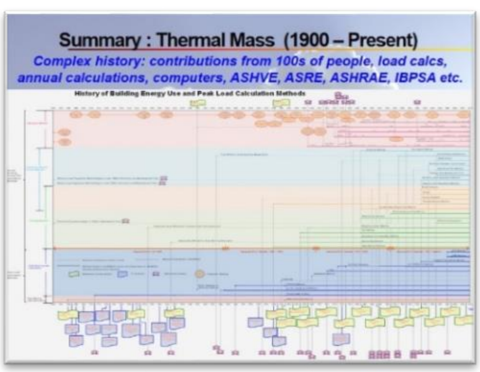


Figure 41: Presentation to IBPSA, August 2012 (continued)

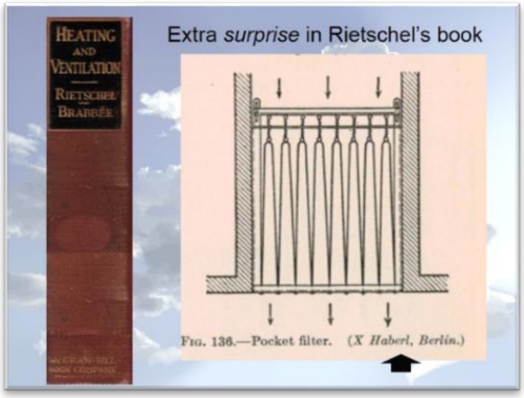
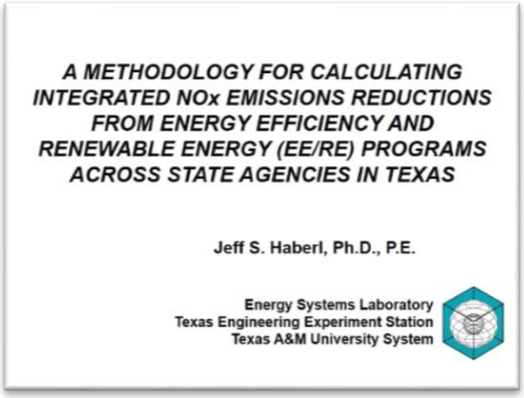
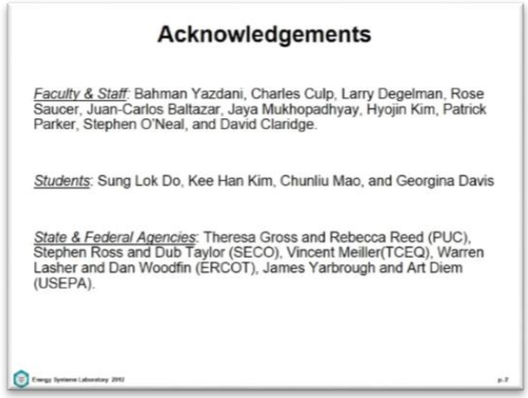
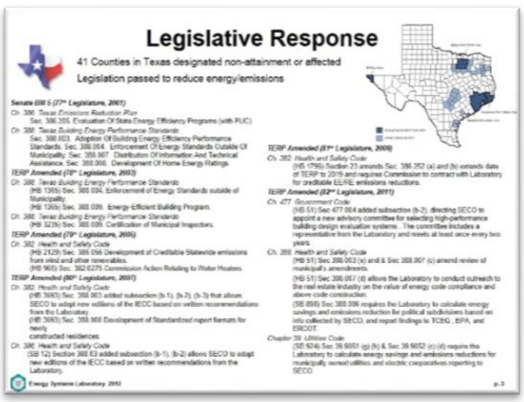


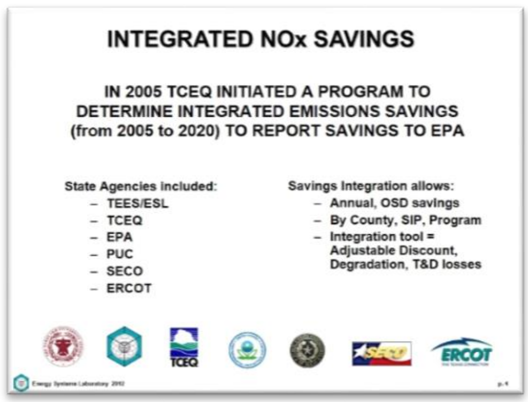
Figure 41: Presentation to IBPSA, August 2012 (continued)

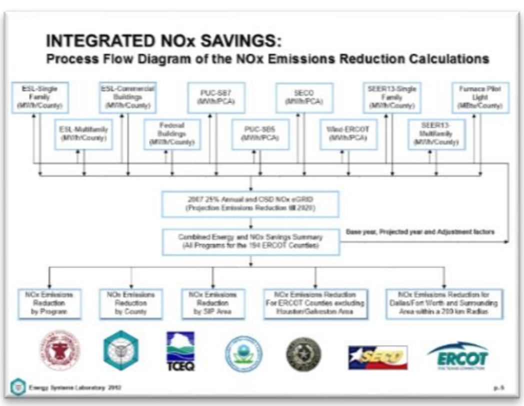
Webinar to the EPA, August 2012











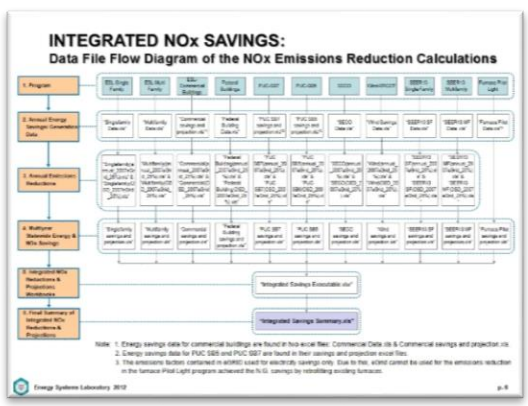
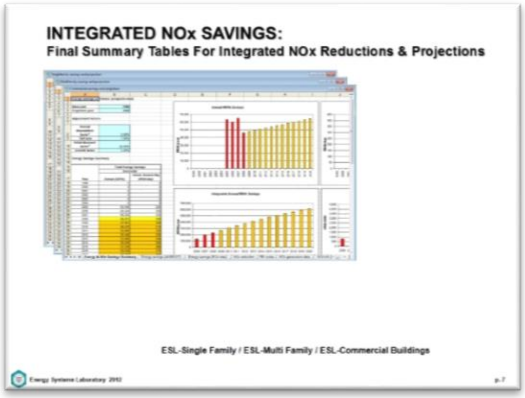
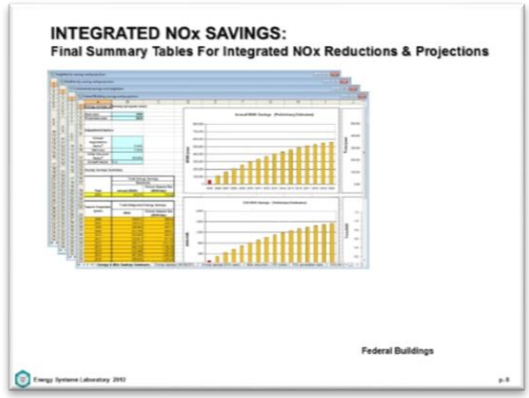
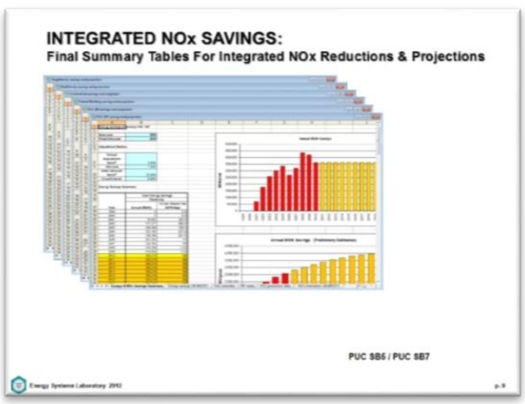
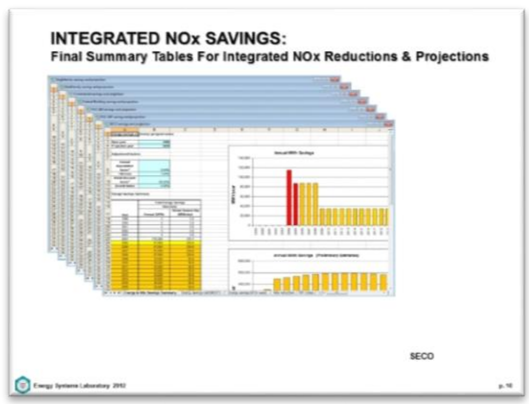


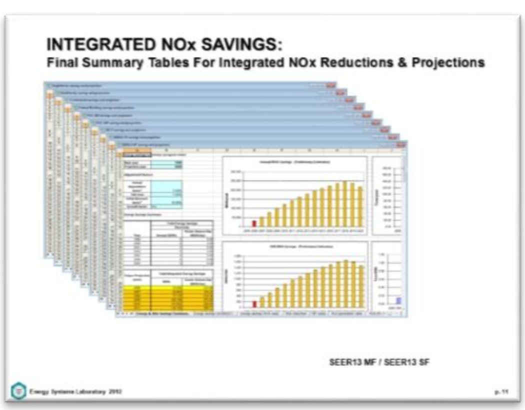
Figure 42: Webinar to the EPA, August 2012











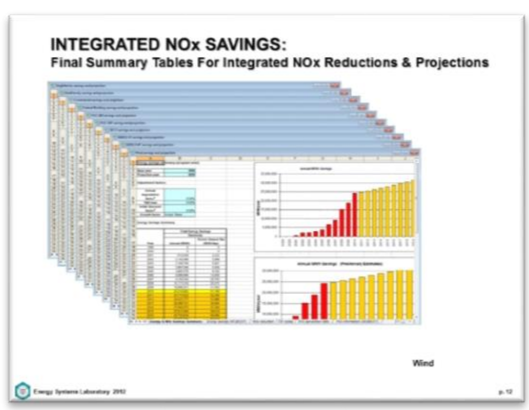
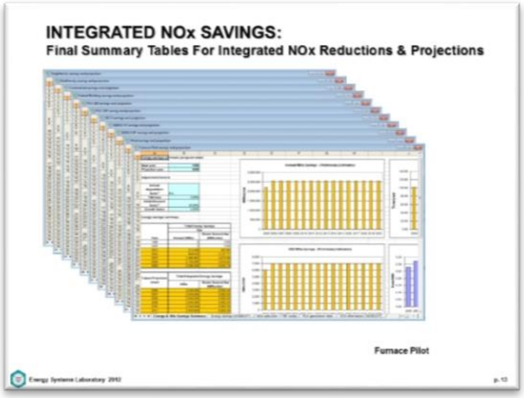
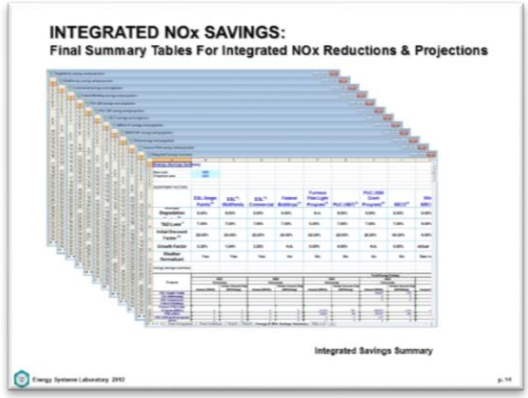
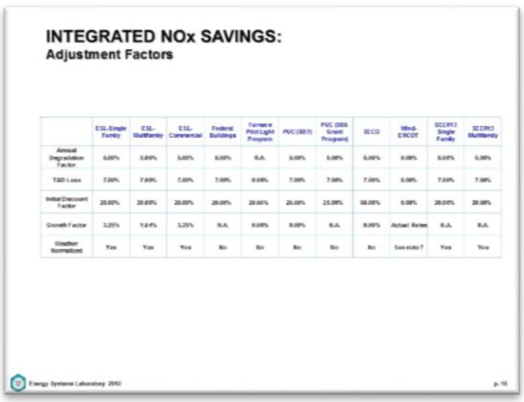
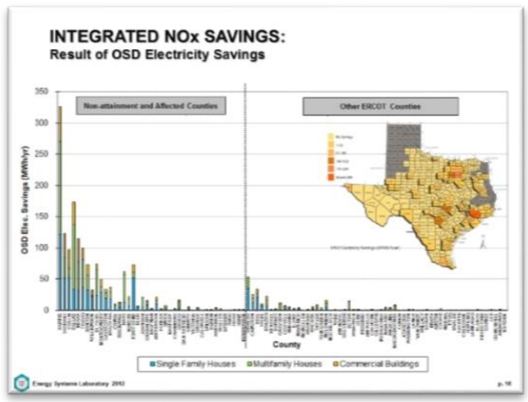


Figure 42: Webinar to the EPA, August 2012 (continued)









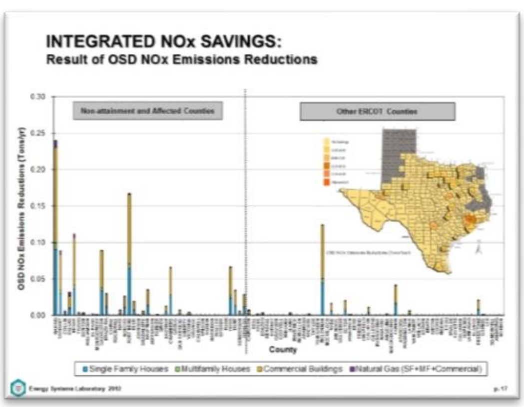
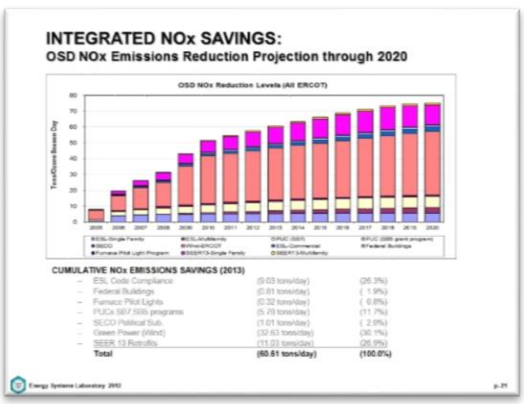
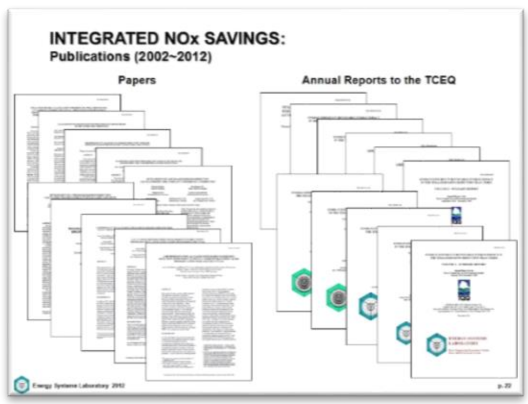


Figure 42: Webinar to the EPA, August 2012 (continued)





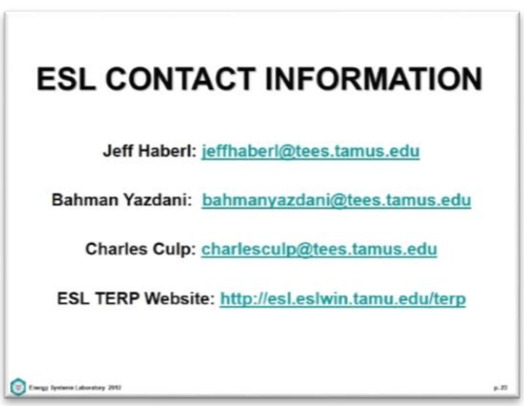
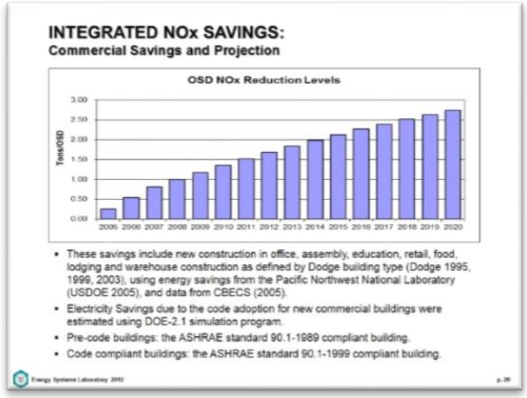
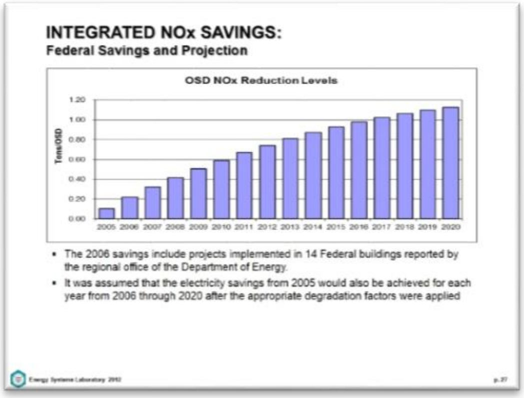
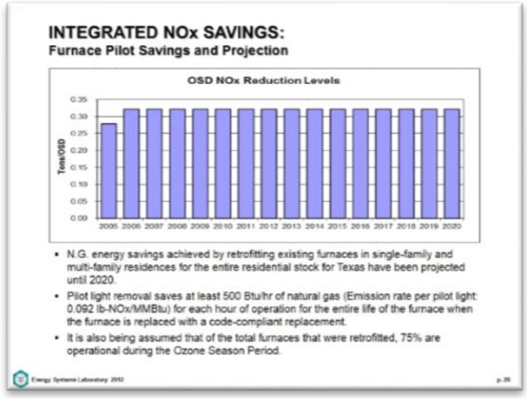


Figure 42: Webinar to the EPA, August 2012 (continued)







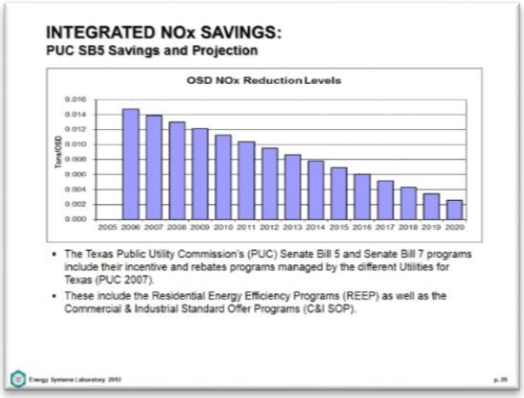
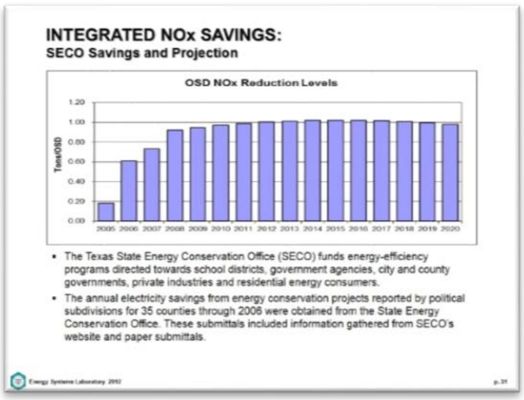
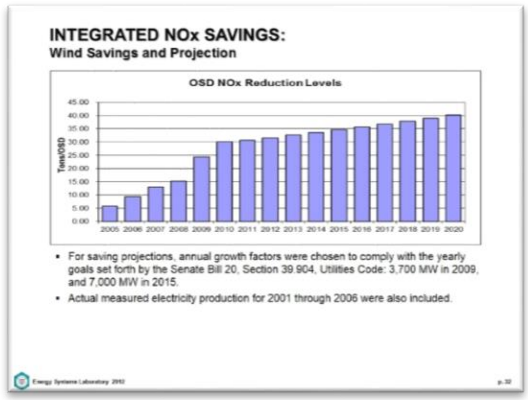
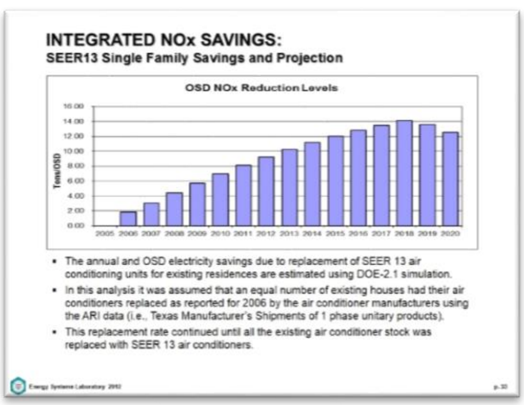
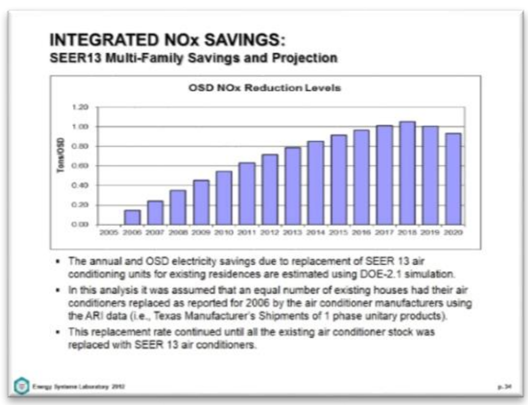


Figure 42: Webinar to the EPA, August 2012 (continued)









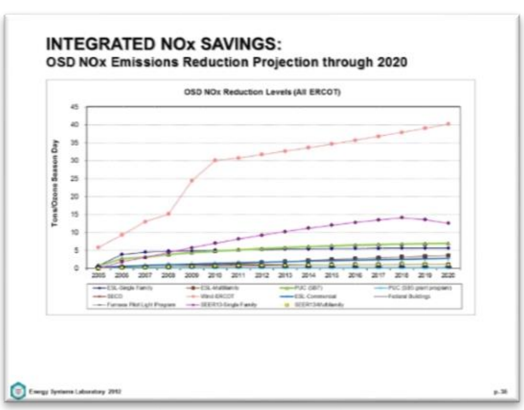
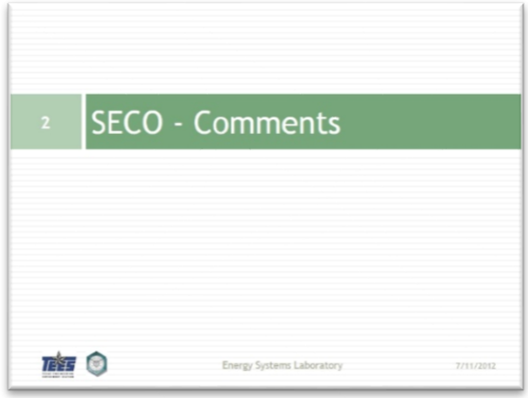
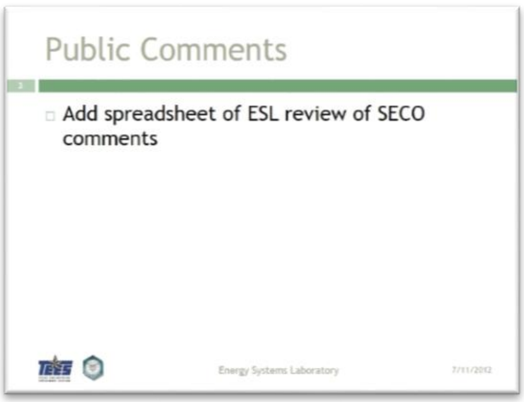
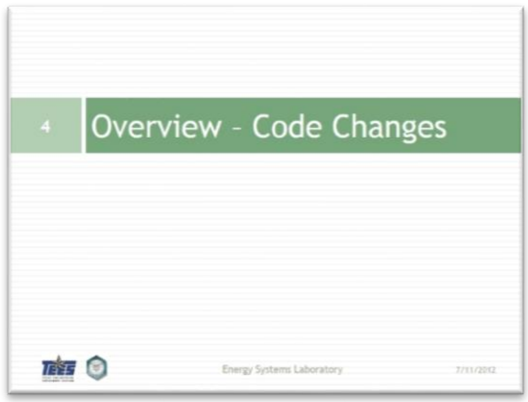


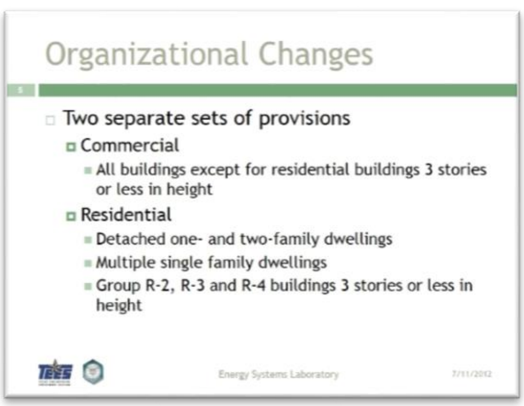
Figure 42: Webinar to the EPA, August 2012 (continued)

Presentation to the City of El Paso, September 2012









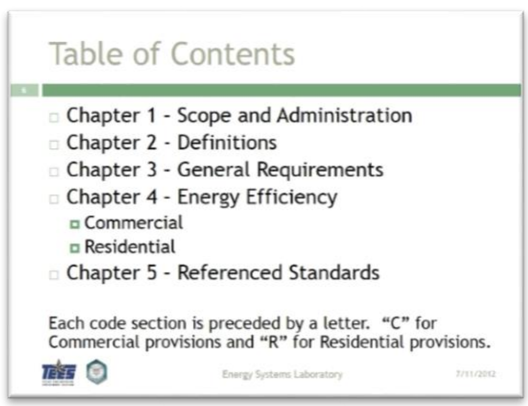
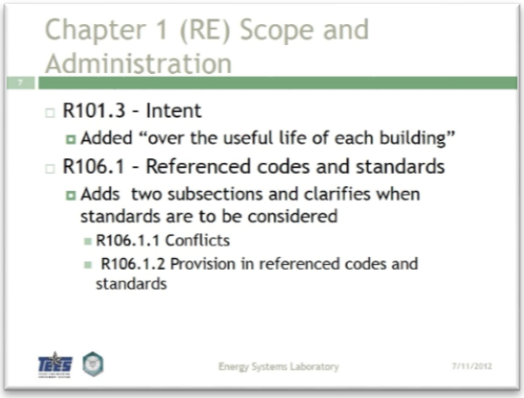
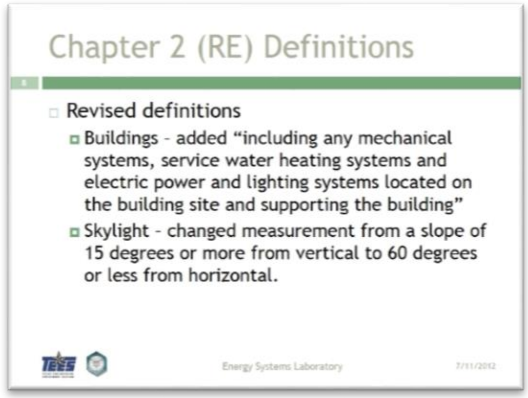
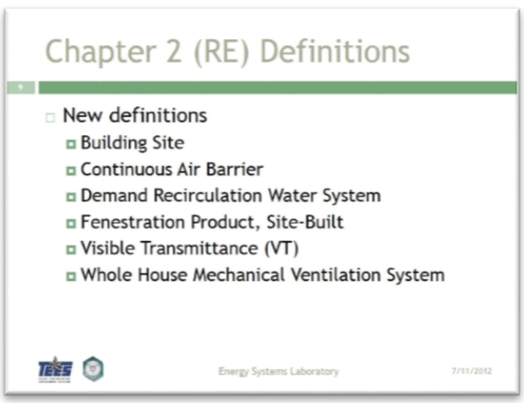
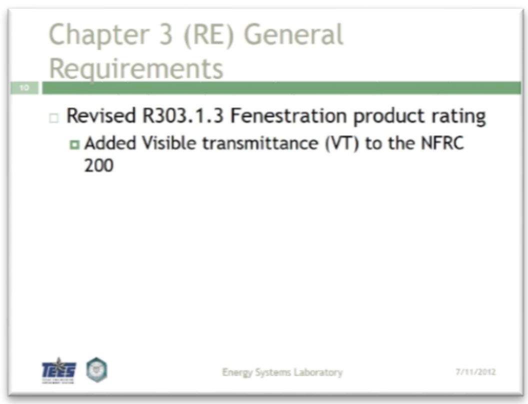


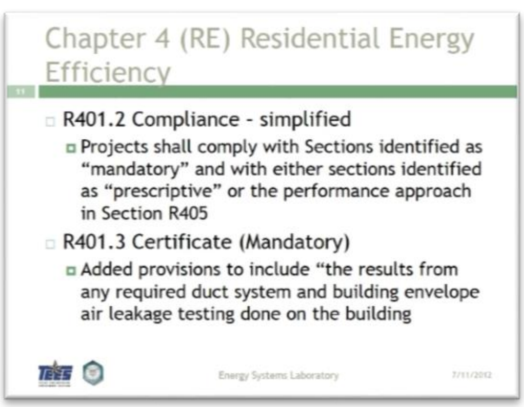
Figure 43: Presentation to the City of El Paso, September 2012











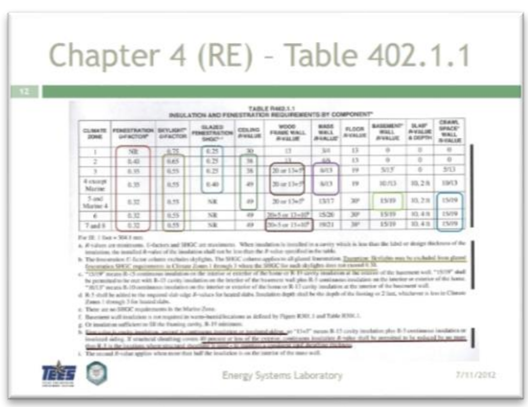
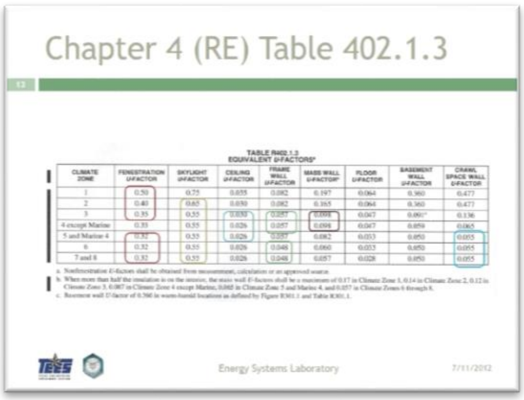
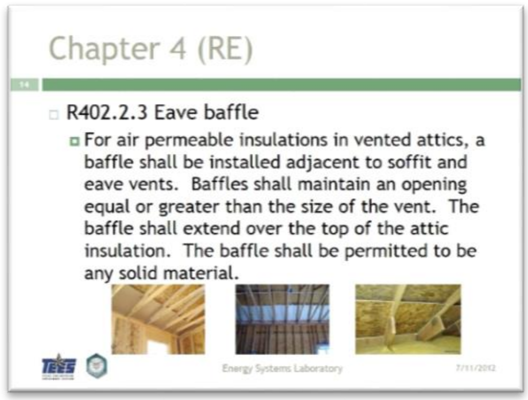
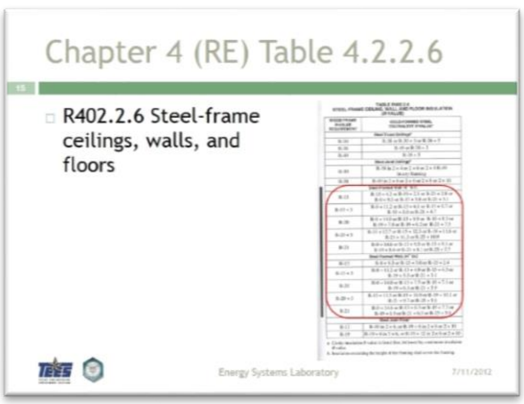
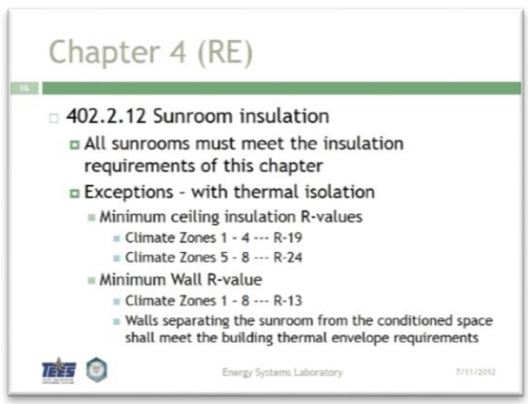


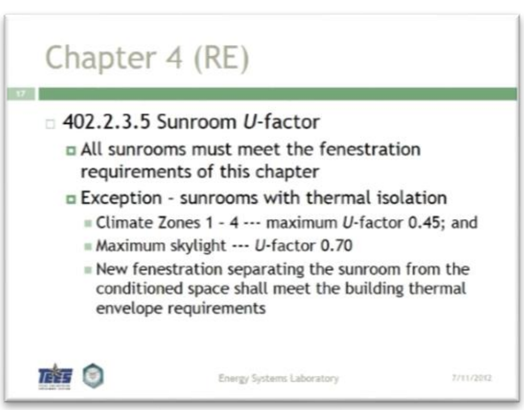
Figure 43: Presentation to the City of El Paso, September 2012 (continued)











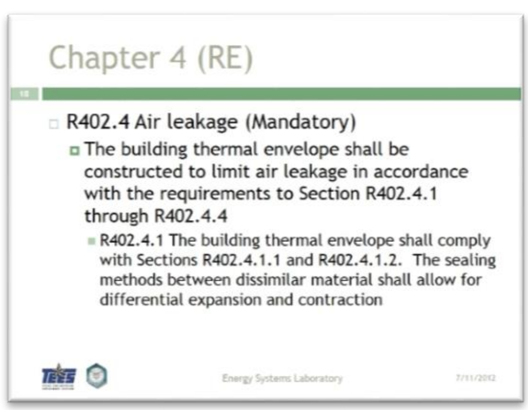
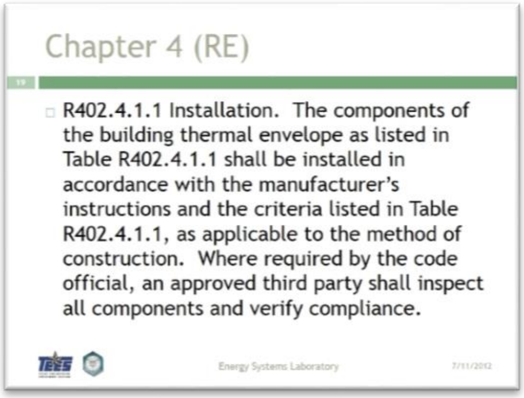
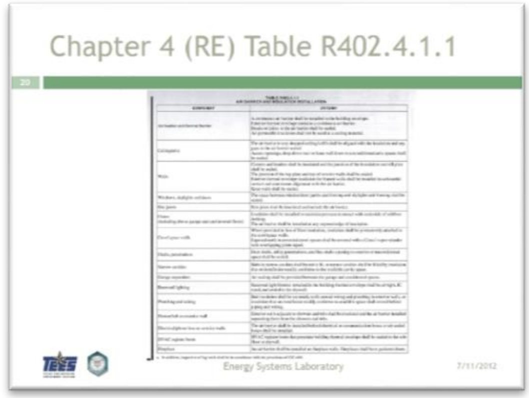
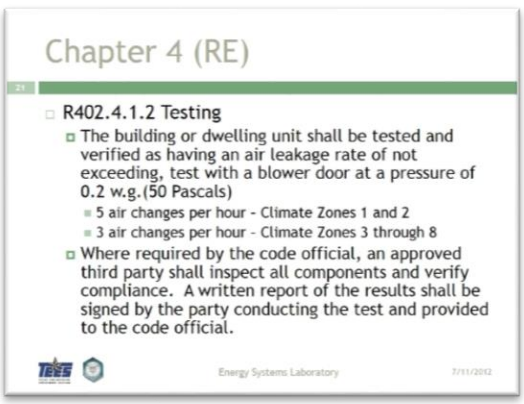
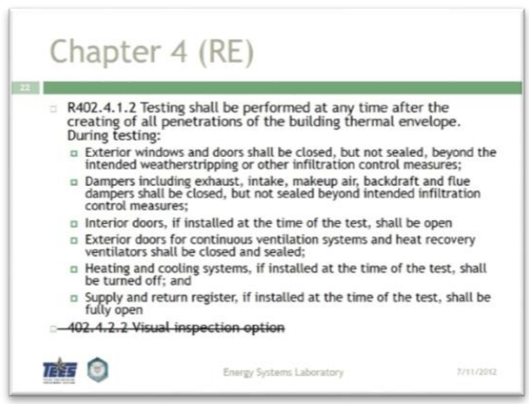


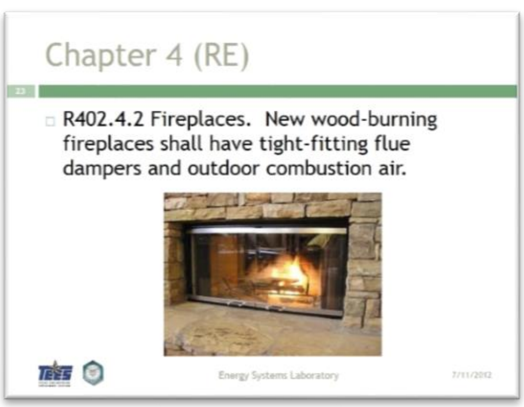
Figure 43: Presentation to the City of El Paso, September 2012 (continued)











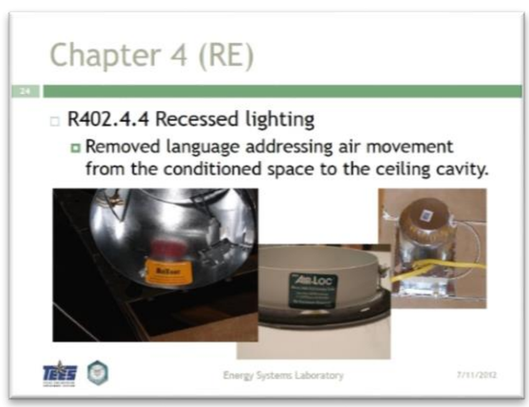
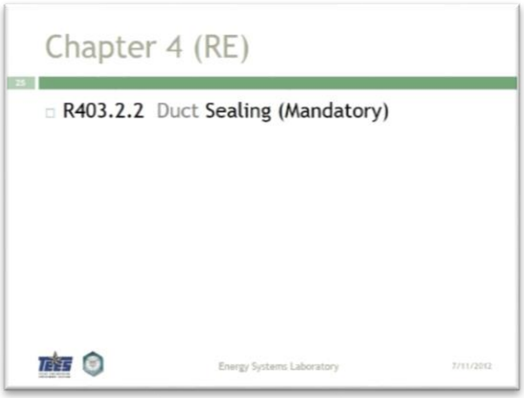
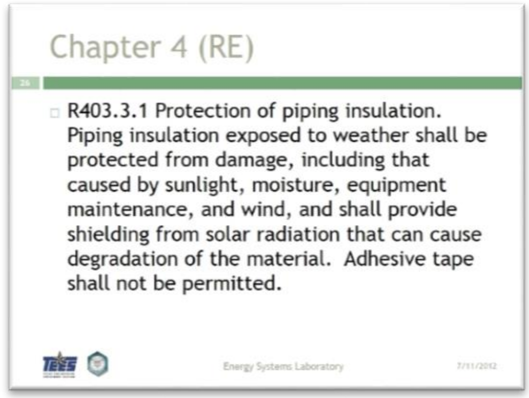
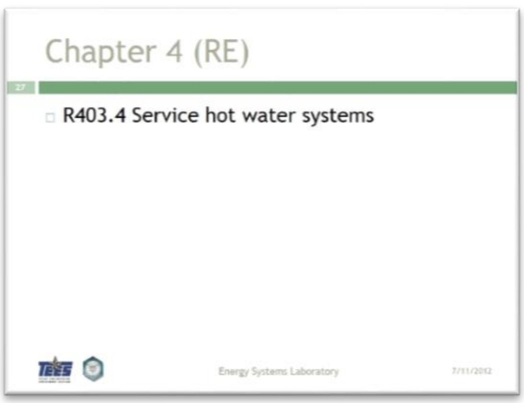
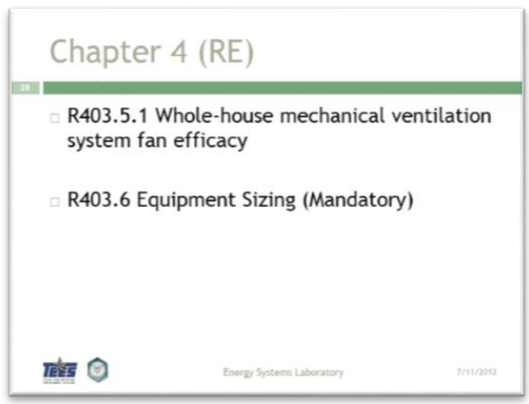


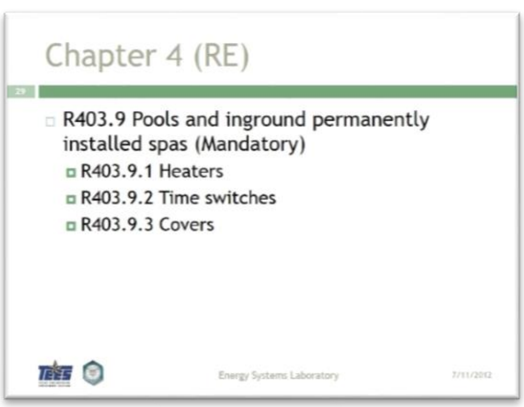
Figure 43: Presentation to the City of El Paso, September 2012 (continued)











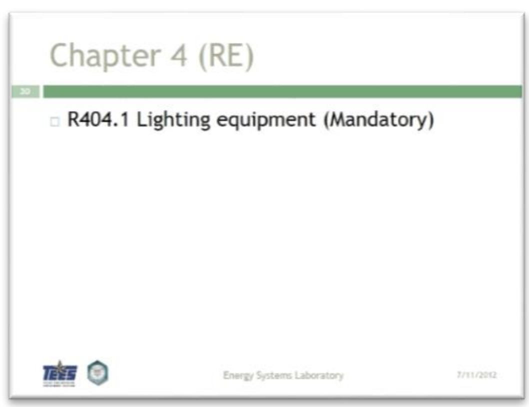
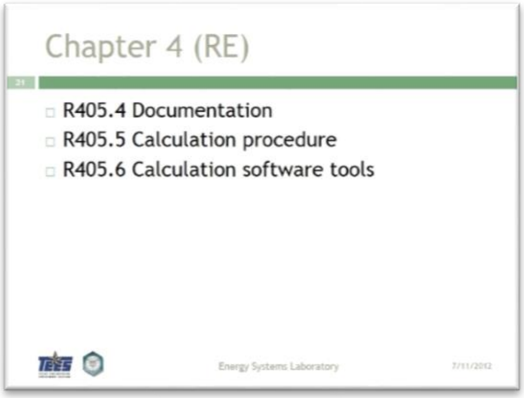


Figure 43: Presentation to the City of El Paso, September 2012 (continued)



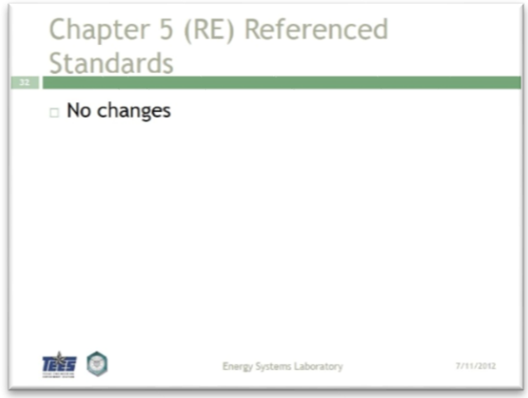
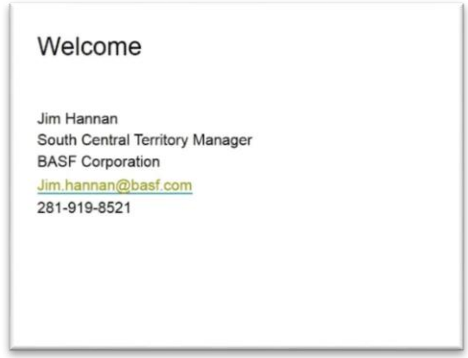
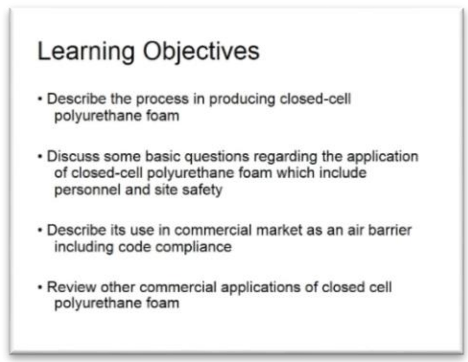


Figure 43: Presentation to the City of El Paso, September 2012 (continued)

Presentation to SPEER, September 2012





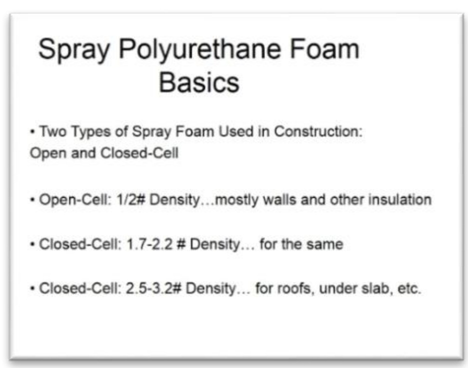
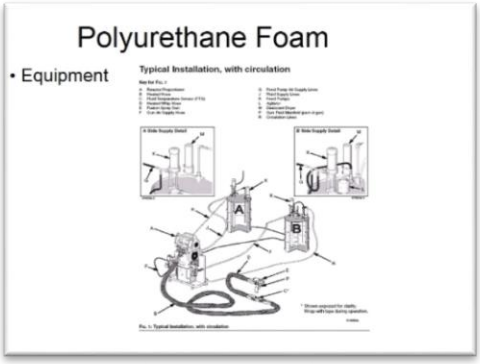
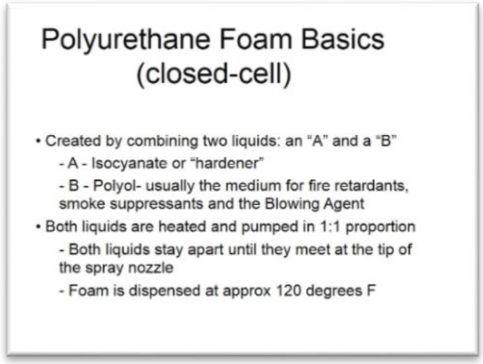


Figure 44: Presentation to SPEER, September 2012 (continued)






BASF Technical Product Data

(1) These physical property values are typical for this material as applied at our development facility under controlled conditions. SPF performance and actual physical properties will vary with differences in application (i.e. ambient conditions, process equipment and settings, material throughput, etc). As a result, these published properties should be used as guidelines solely for the purpose of evaluation. Physical property specifications should be determined from actual production material.

The above data was collected from samples prepared using the following equipment configuration:

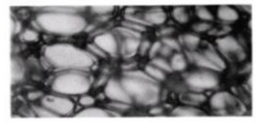
- Gusmer® H-20/35 proportioner set at 1:1 volume ratio with 50 ft of heated delivery hose
- Gusmer® GX-7 spray-gun configured with a #1 mix module and #70 PCD and/or GAP spray-gun configured with a #1 mix chamber
- Process temperature settings: Isocyanate 130°F; Resin 130°F; Hose 130°F
- Process pressure: 1000 psig minimum while spraying

(2) The data chart shows the R-value of this insulation. "R" means resistance to heat flow. The higher the R-value, the greater the insulating power. Compare insulation R-values before you buy. There are other factors to consider. The amount of insulation will depend upon the climate, the type and size of your structure, and the fuel use patterns. If you buy too much insulation it will cost you more than what you will save on fuel. To achieve proper R-values, it is essential that this insulation be installed properly.

Figure 44: Presentation to SPEER, September 2012 (continued)

Closed-Cell Basics

- "Exothermic" chemical reaction - when the two components meet
  - Heat and pressure create more heat
- It's the Blowing Agent (BA)…
  - It is the BA that makes the physical properties
  - BA is twice as efficient as a thermal insulator as air
  - Low density foams - don't use a gas blowing agent
- Microscopic cell structure created in this fashion is filled with an insulating gas
  - Over One Million closed cells per cubic inch



100X Magnification of closed-cell foam

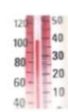
Closed-Cell Basics

- Liquids reach "cream and tack-free time" between 3 and 9 seconds.
- Foam actually expands away from the substrate creating foam, insulation, and vapor resistance: all in a single application.
- "Creep"
  - When foam grows laterally into gaps, crevices and other imperfections conventional insulation cannot get.

Closed-Cell Basics

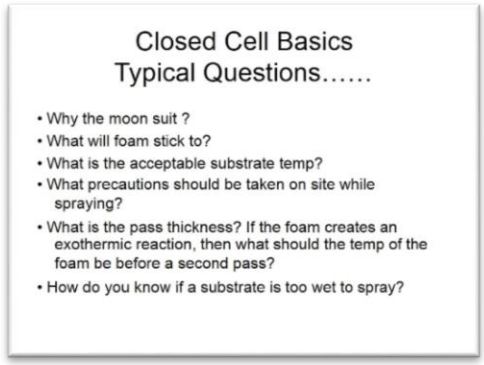
- Cure Time
  - Time at which 90% of the physical properties of foam are realized
- At 72F, 90% of physical properties are evident within one hour
  - Additional 10% within 24 to 72 hours
- As exothermic reaction (heat) dissipates, curing slows
  - Cooler substrates and ambient temperatures slow cure time

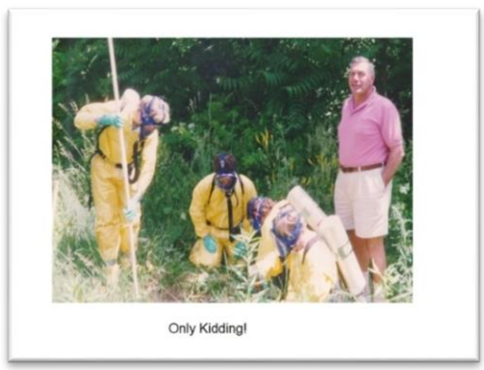
Temperatures

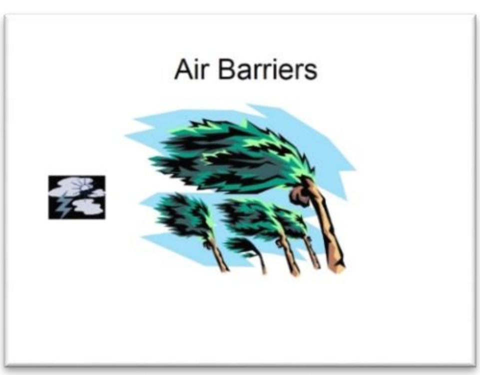


- 20 F to 60 F **Cold or Winter**
- 50 F to 80 F **Normal or Fast**
- 60-90 F+ **Slow or Hot**
- The foam reaction can be controlled with the formulation to provide for the optimum foam performance at different temperature ranges
- Keeping temperatures of the drums at 70 F helps minimize equipment processing problems!

Figure 44: Presentation to SPEER, September 2012 (continued)







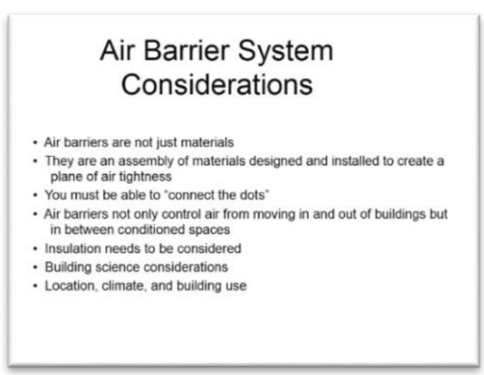
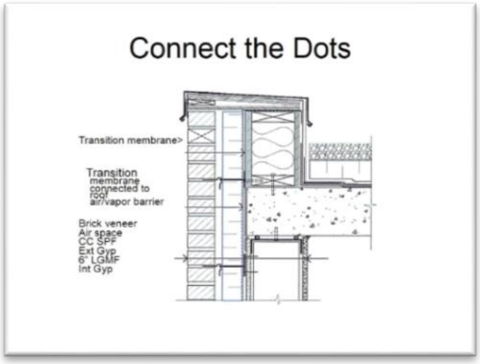
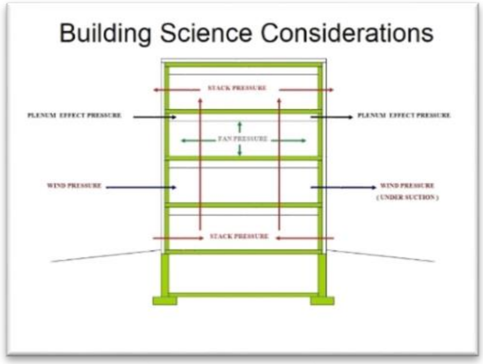


Figure 44: Presentation to SPEER, September 2012 (continued)





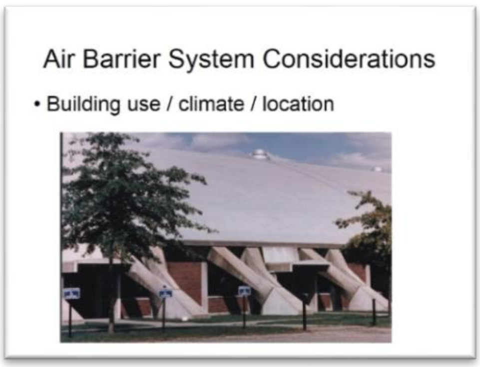
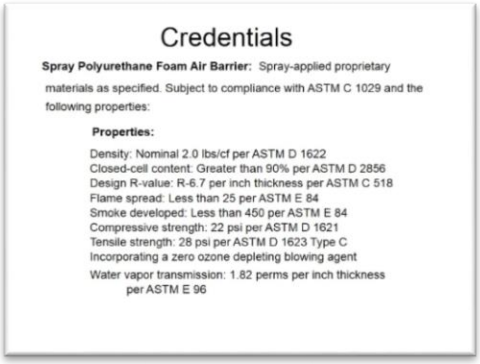
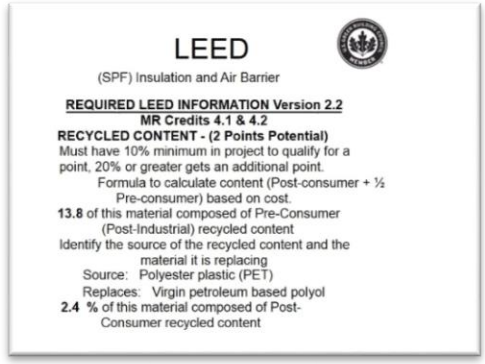
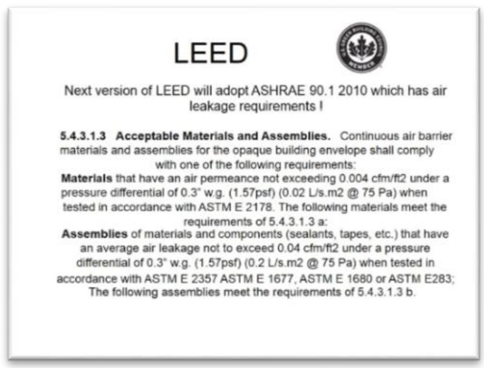
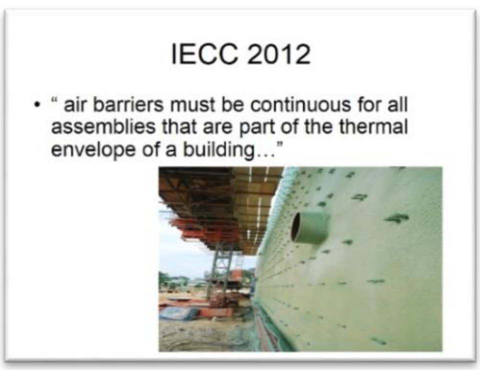


Figure 44: Presentation to SPEER, September 2012 (continued)









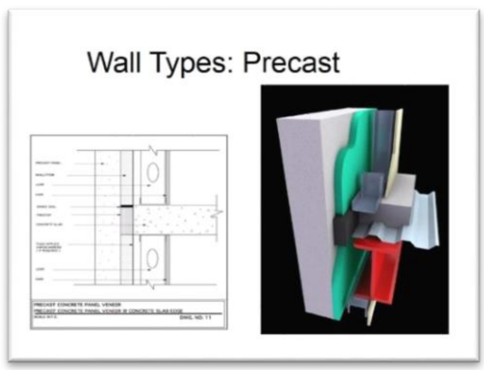
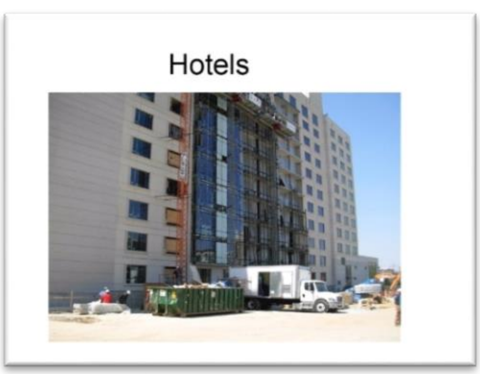


Figure 44: Presentation to SPEER, September 2012 (continued)



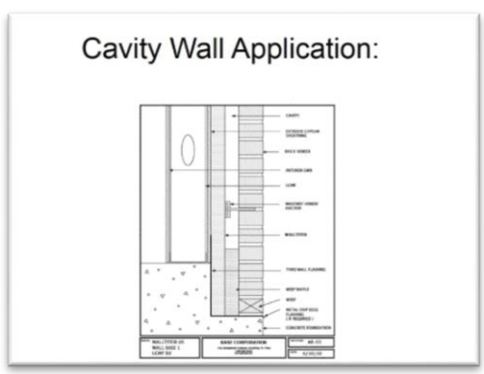
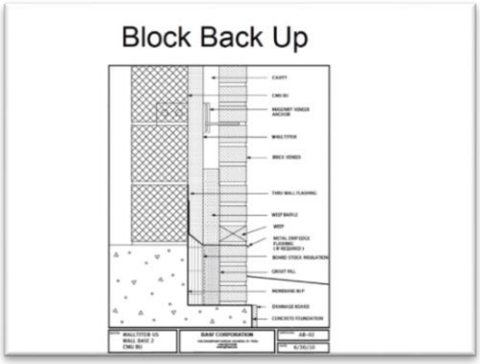


Figure 44: Presentation to SPEER, September 2012 (continued)

Figure 44: Presentation to SPEER, September 2012 (continued)



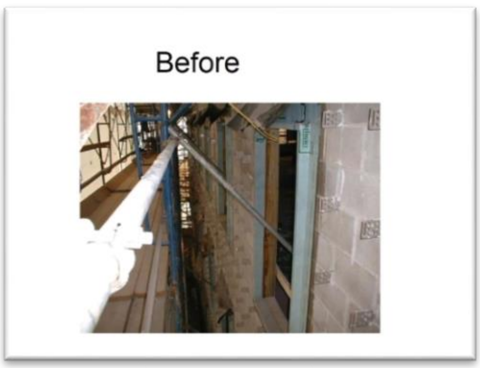
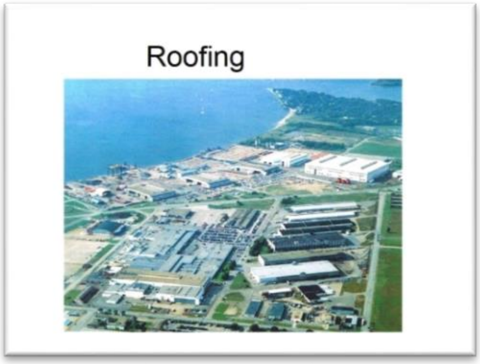
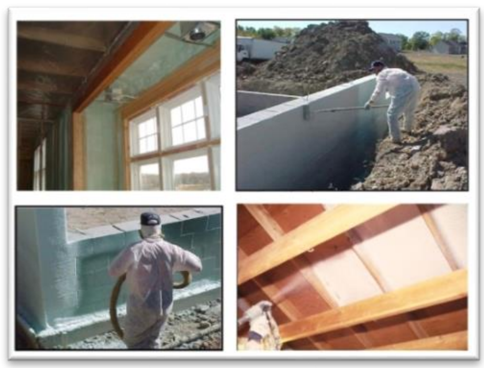
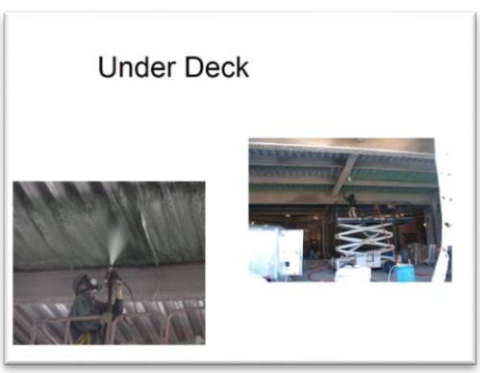


Figure 44: Presentation to SPEER, September 2012 (continued)

Figure 44: Presentation to SPEER, September 2012 (continued)







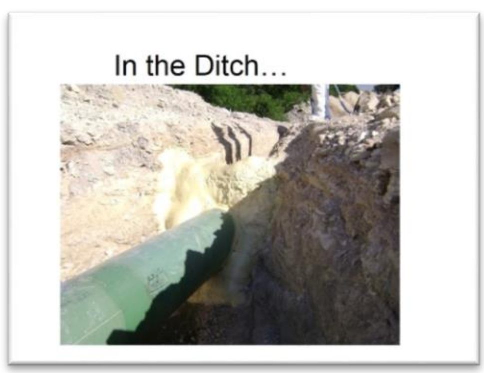
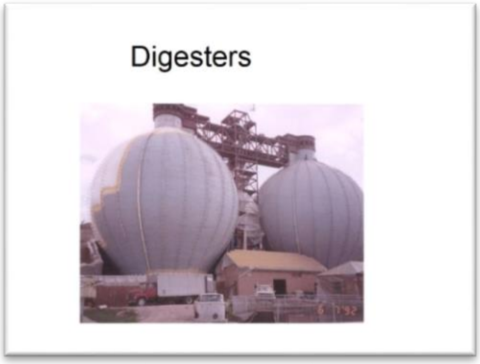
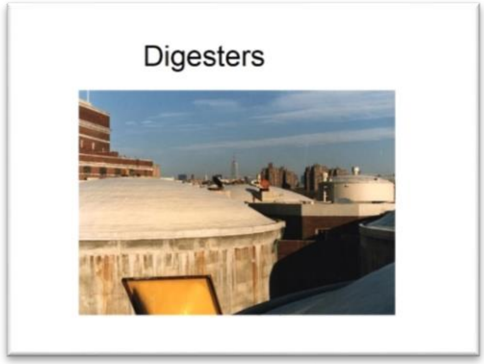
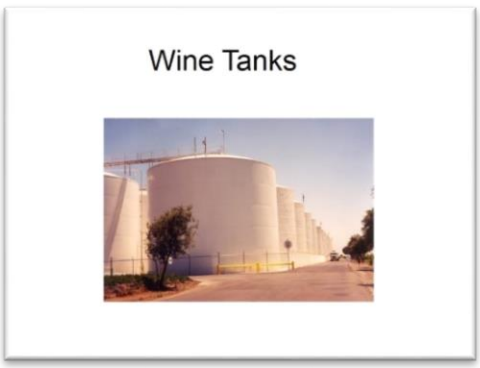


Figure 44: Presentation to SPEER, September 2012 (continued)







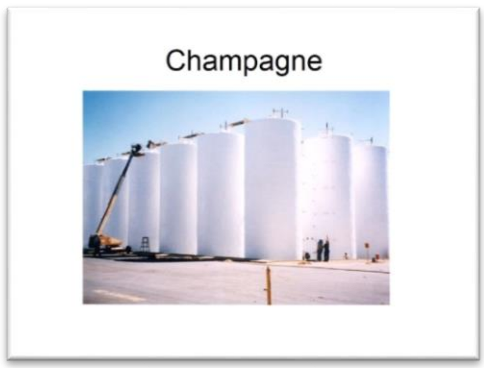


Figure 44: Presentation to SPEER, September 2012 (continued)

Coated Foam Roofing Systems

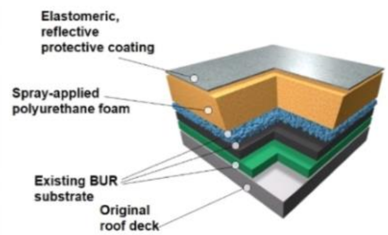
3

Learning Objectives

- Describe the application developments of coated foam roofing systems
- Explain the construction detailing benefits of a spray polyurethane roofing installation
- Describe the performance attributes exhibited in coated foam roofs
- Identify the environmental and building sustainable contributions of coated foam roofing systems

4

Coated Foam Roofing System



5

Industry History

• 1930s	WWII and product development
• 1940s	Process improvements
• 1960s	Gusmer field processing equipment
	SPF roof and wall insulation applications
• 1970s	Silicone coatings developed
	Energy and Insulation influence
	Naval study and acceptance - UL 1256
	Dow Corning warranty program standard
• 1980s	Naval standards spread
• 1990s	Robotic Technology

6

Industry History

• 1990	SPFD Accreditation program
• 1991	CFC's phase out to HCFC's
• 1996	NRF Study Phase 1
• 1997	NRCA SPF Roof Manual
• 1998	Report Issued, Positive Results
• 2003	NRF Study Phase 2
• 2004	HCFC 141b phase out to HFC 0 ozone depleting blowing agents
• 2005	Wide spread acceptance as a superior insulation and energy saving system

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Figure 44: Presentation to SPEER, September 2012 (continued)

Industry Study - Existing SPF Roof Systems - Phase 1 1998

- Study by National Roofing Foundation (NRF) of existing spray polyurethane foam roof systems
- Lead by Rene Dupuis, Ph.D., PE, Structural Research, WI, a renown roofing expert.
- A 2 year comprehensive study
- Investigated 140 roofs in 5 different regions across U.S.

9

Industry Study - Existing SPF Roof Systems - Phase 1 1998

- The study investigated the following roof profiles:
  - SPF roofs in Various Climates
  - SPF & Acrylic Coatings
  - SPF & Urethane Coatings
  - SPF & Silicone Coatings
  - SPF & Aggregate covering Systems

10

Industry Study - Existing SPF Roof Systems - Phase 1 1998

- The study documented the following performance:
  - Average roof maximum performance = 14.2 years
  - Average roof size = 40,541 sq. ft.
  - 97 percent customer satisfaction
  - Conclusion: SPF roofs are performing very well

11

Industry Study - Field Performance of Roof Flashings - Phase 2 2003

- Study by National Roofing Foundation (NRF) of existing spray polyurethane foam roof systems
- Lead by Rene Dupuis, Ph.D., PE, Structural Research, WI, a renown roofing expert.
- Investigated 188 roofs across U.S.
- Roof age - Up to 31 years old
- 40 projects in the study were recoated at an average age of 15 years
- Self flashing of SPF roofing systems was determined to be satisfactory and could eliminate the cost of counter flashings and control joints

12

Industry Study - Field Performance of Roof Flashings - Phase 2 2003

- The study documented the following performance:
  - SPF details are by nature very simple
  - SPF details often do not use counter flashings
  - Conclusion: SPF and appropriate coatings were observed to work quite well as singular flashing systems

13

Industry Study - Field Performance of Roof Flashings - Phase 2 2003

- SPF details are by nature very simple

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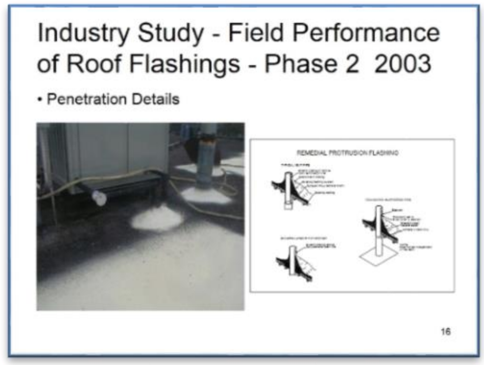
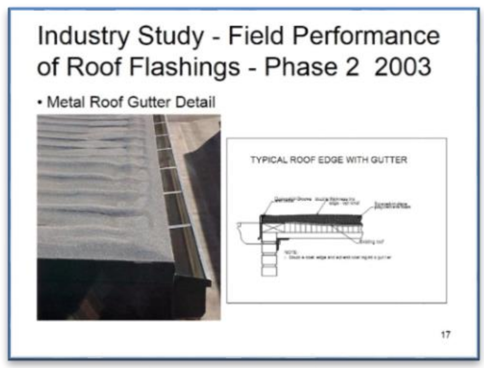
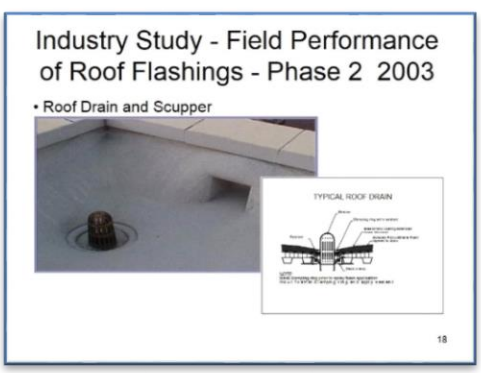
Figure 44: Presentation to SPEER, September 2012 (continued)







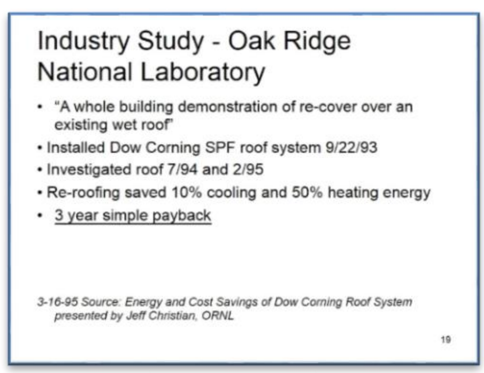


Figure 44: Presentation to SPEER, September 2012 (continued)

Industry Program - Performance Based Studies Research Group

- The ***ALPHA*** Program
  - The Program is the result of studies conducted by the Performance Based Studies Research Group (PBSRG) at Arizona State University
  - ***ALPHA*** has defined quantifiable, verifiable standards for excellence in roof performance
  - The Performance Information Procurement System (PIPS) is unique in its ability to go beyond basic cost and specification criteria to identify the true value of contractors and systems based on measurable, quality-related factors

20

Industry Program - Performance Based Studies Research Group

- The ***ALPHA*** Program
  - An ***ALPHA*** roof provides high performance by combining the efforts of the leading coating manufacturer, the highest quality SPF and highly qualified contractors
  - The ***ALPHA*** Program is voluntary and open to all manufacturers & contractors who meet the same high level of scrutiny and performance

21

SPF Product Basics

- Chemistry of SPF roofing systems
  - No volatile organic compounds (VOCs)
  - Zero-ozone-depleting blowing agents
    - No CFCs of HCFCs
  - ENERGY STAR® listed insulation material
  - ENERGY STAR® listed coatings

22

SPF Product Basics

- 245fa Water Blowing Agents - 01-01-2005
- Standard SPF Roofing System

- Closed Cell Content	>90%
– Compressive Strength	50 psi
– Thermal Resistance initial	0.15 (6.7)
– Thermal Resistance aged	0.17 (6.3)
– Dimensional Stability - 28 days	+2.5%
– Water Absorption	0.36 %
– Water Vapor Transmission	0.8 perms
– Passes UL 790	

23

Recycled and Renewable Content

- Post-consumer scrap plastics reprocessed into B-component ingredients
- Renewable or plant-grown materials (sugar beets, cane products) processed into B-component ingredients

24

SPF Product Basics

- Application with standard equipment
- Smooth surface texture
- Seamless insulating air barrier

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Figure 44: Presentation to SPEER, September 2012 (continued)

Elastomeric Coating Basics

- Chemistry of elastomeric coatings
  - Acrylic - Little to no VOCs
    - Least expensive
    - Requires more coats to achieve required millage
    - Requires temperatures above 50 F for curing
    - Requires good drainage
    - Available in white and most colors
    - 50-60% solids
  - Silicone - Low VOC coating
    - Moderate price
    - UV stable and chemical resistant
    - Best weathering resistance with renewal after 15+ years
    - Not for heavy traffic on roof
    - Available in white, beige or gray colors
    - 80-97% solids

26

Elastomeric Coating Basics

- Chemistry of elastomeric coatings
  - Polyurethane - Low VOC coating
    - Moderate to High priced
    - Can use an alaphatic topcoat for UV stability
    - Uses organic solvents which are VOCs
    - Toughness against hail and roof traffic
    - Good chemical resistance
    - 70-80% solids
  - Polyurea - No VOCs
    - 100% solids
    - Very fast cure
    - Most durable coating
    - Requires specialized equipment and applicator

27

Elastomeric Coating Basics

- Alternative Membrane Coverings
  - EPDM (ethylene-propylene-diene-monomer)
  - TPO (thermoplastic-polyolefin)
  - PVC (polyvinyl-chloride)

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Performance - Key Features

- Seamless protection from roof edge to edge

29

Performance - Key Features

- Self-Adhered

30

Performance - Key Features

- SPF is self-flashing - creating quick and effective waterproofing seals

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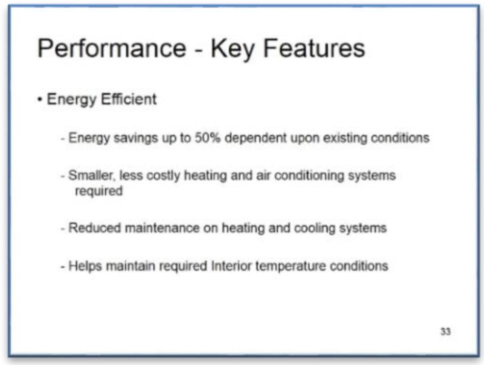
Figure 44: Presentation to SPEER, September 2012 (continued)



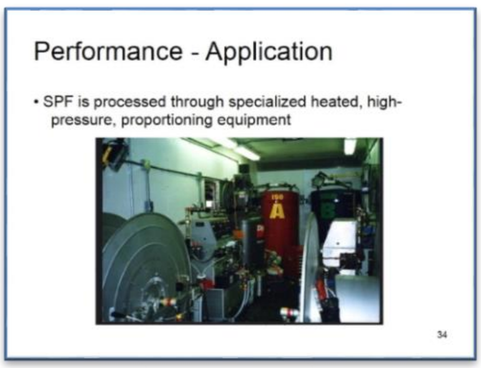
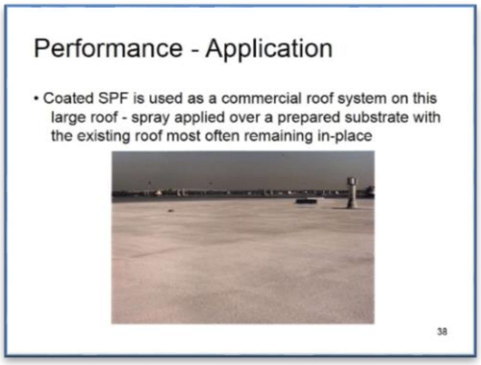


Figure 44: Presentation to SPEER, September 2012 (continued)



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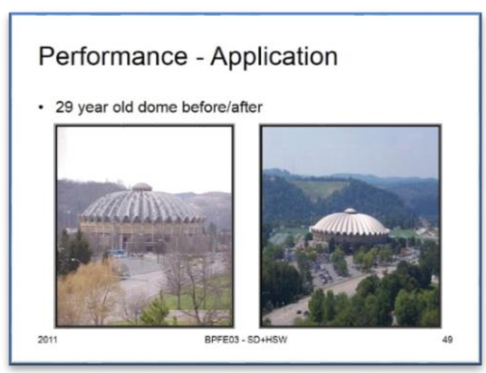

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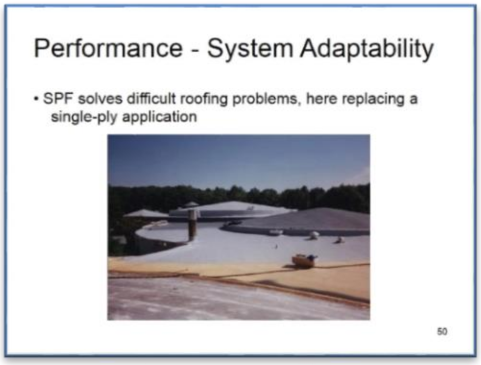

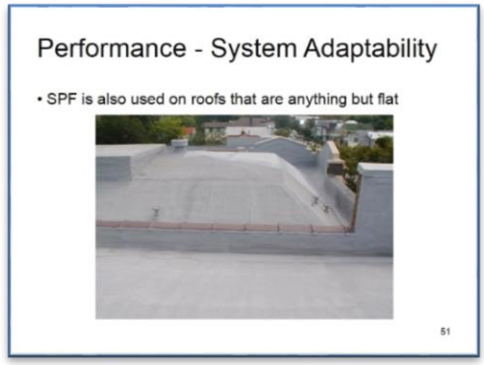

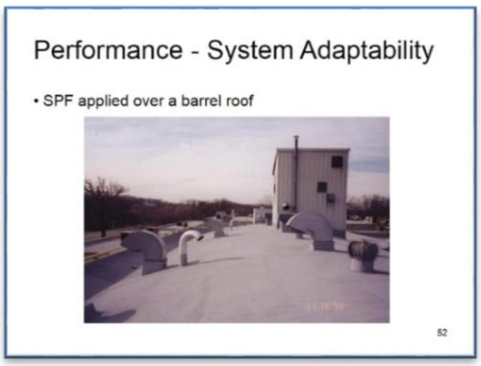

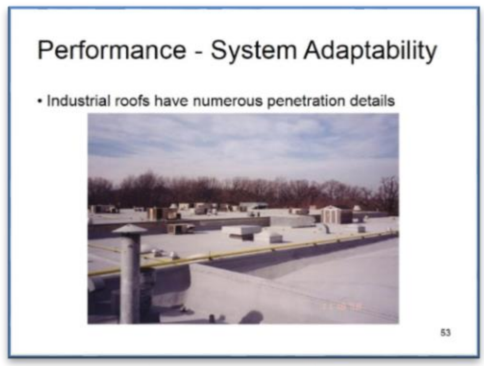

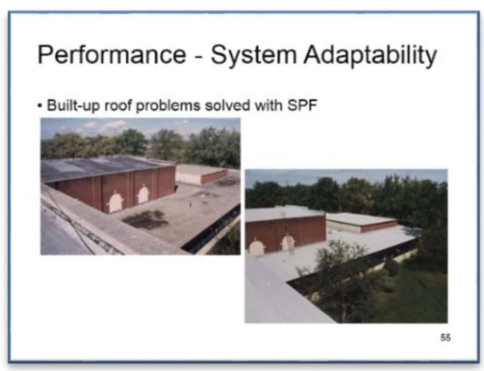

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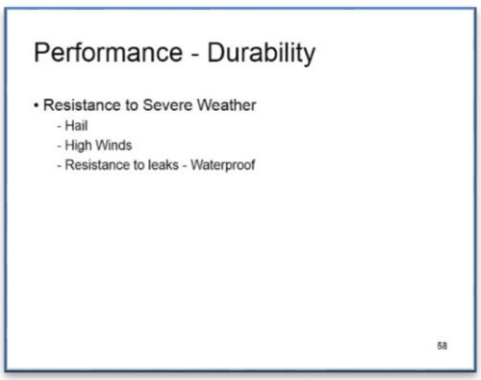

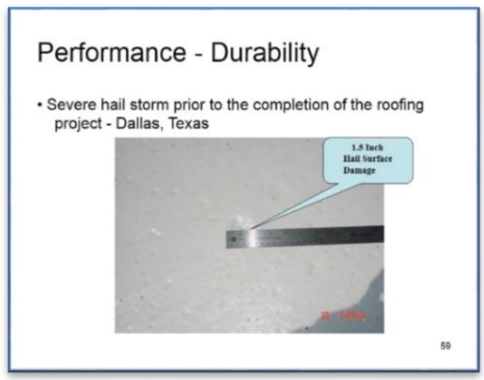

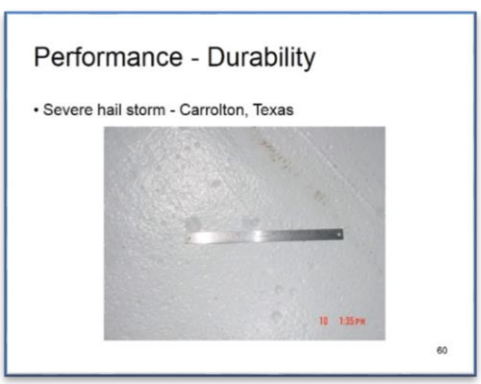

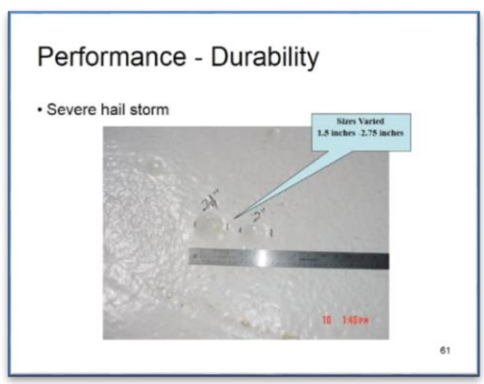

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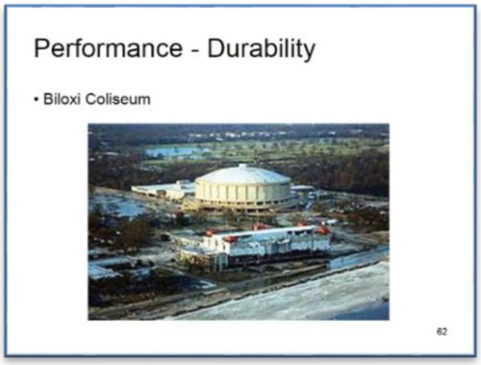

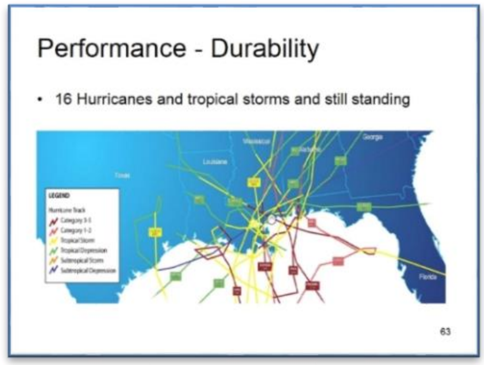

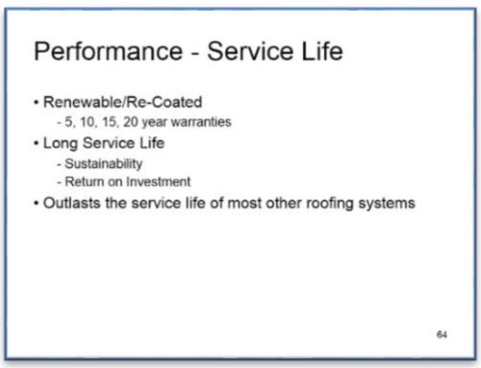

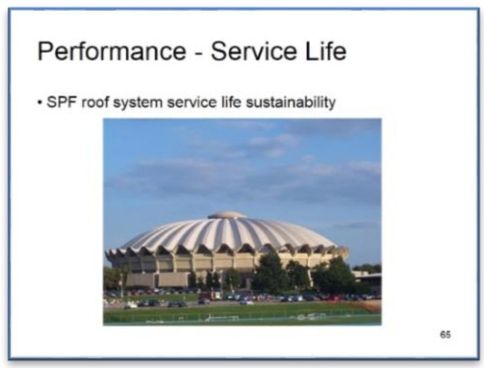

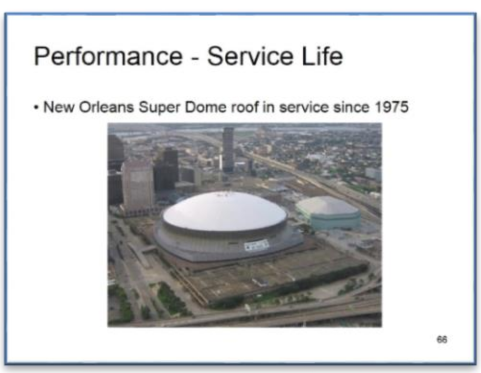

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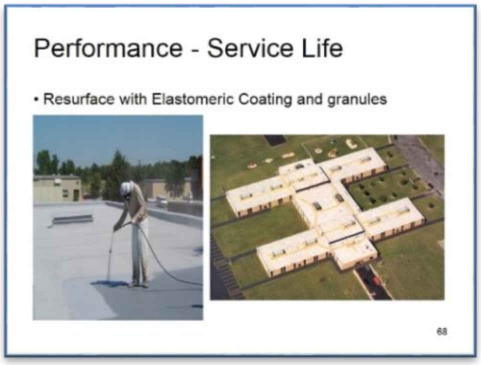

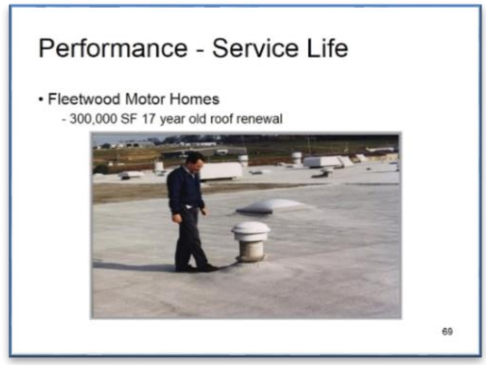

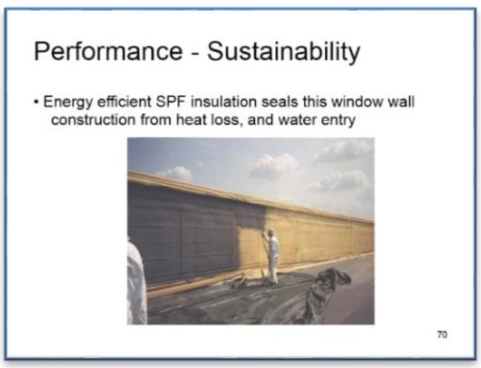

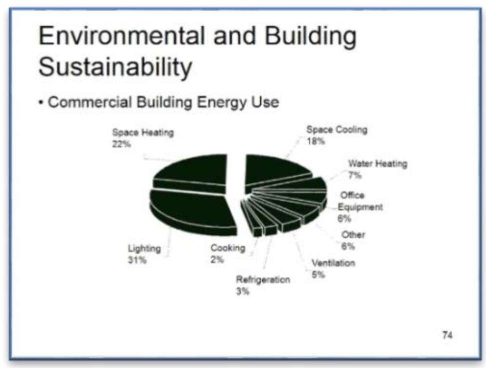

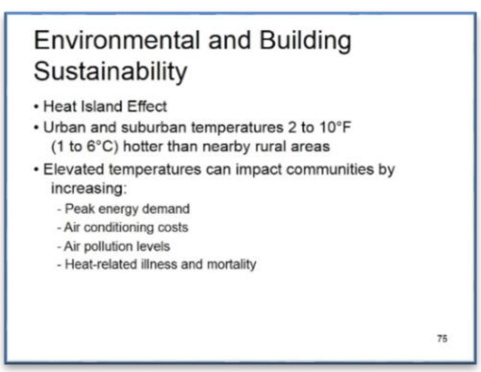

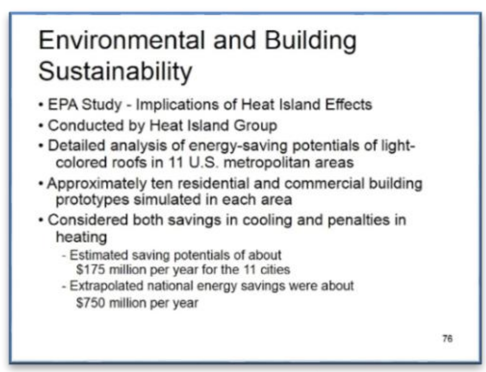

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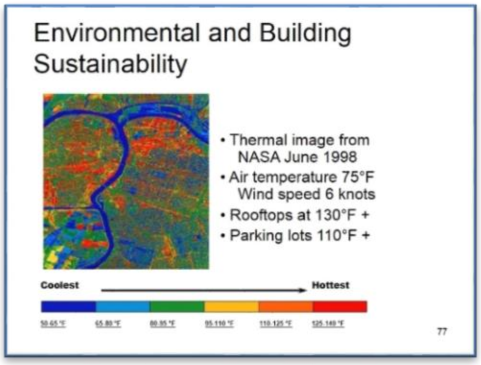

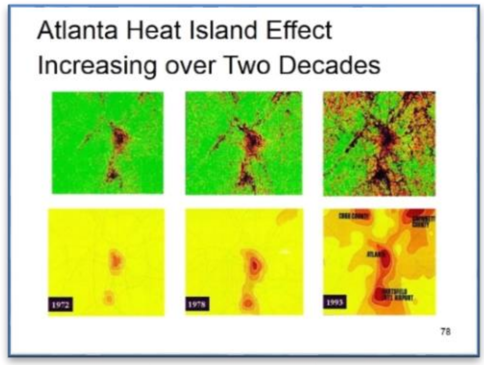

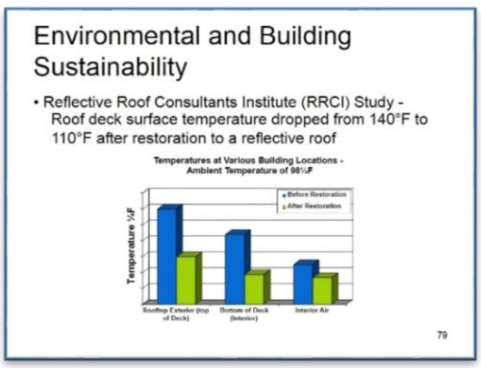

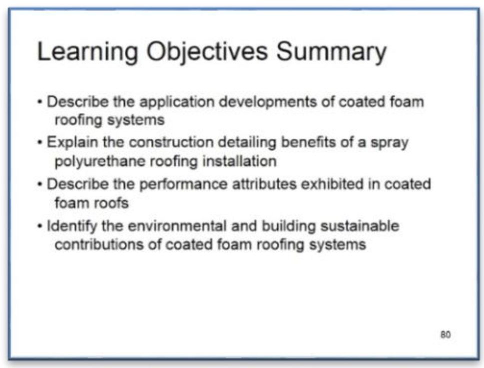

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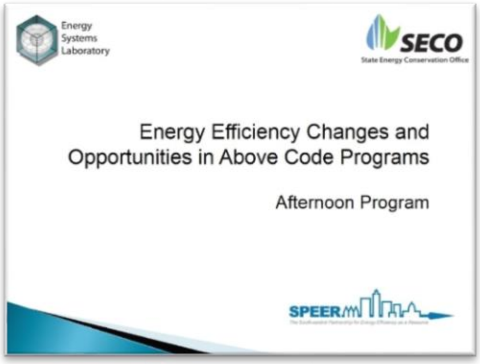

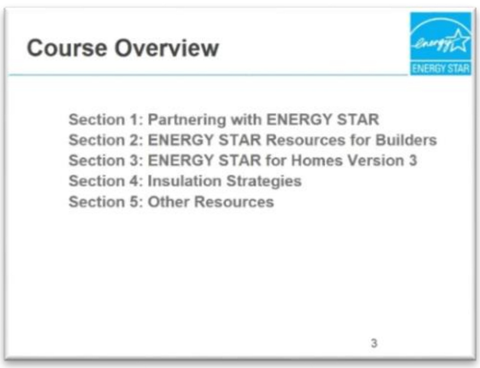

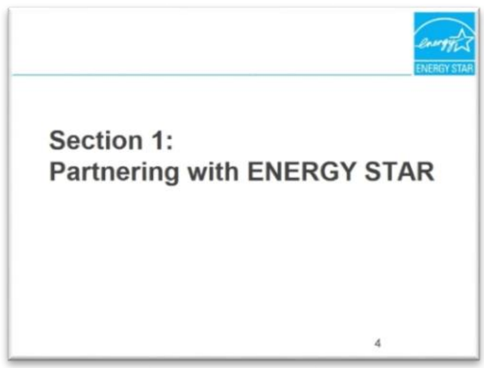

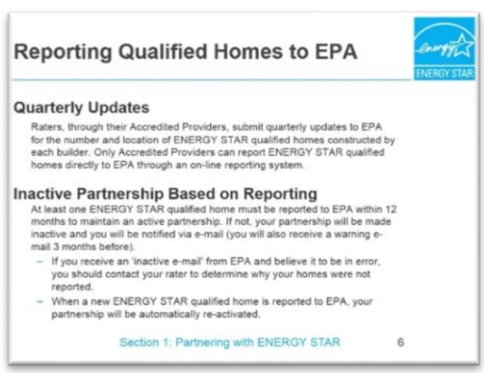

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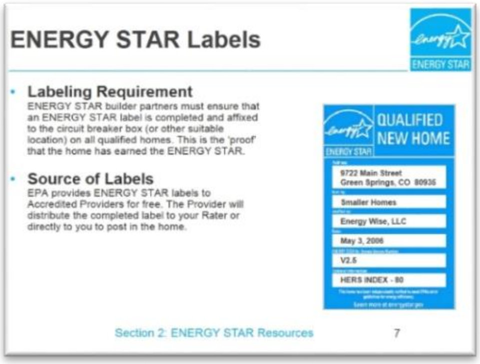
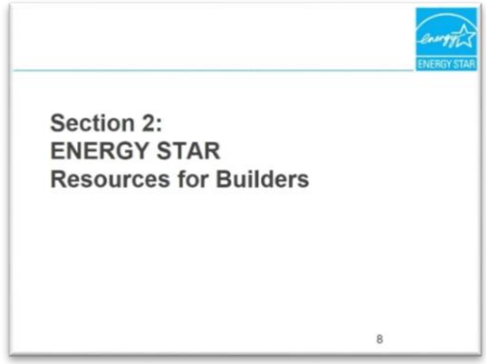
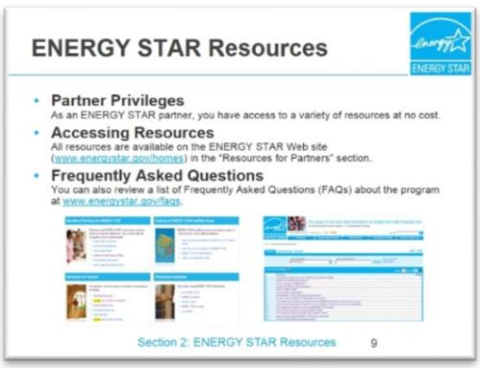
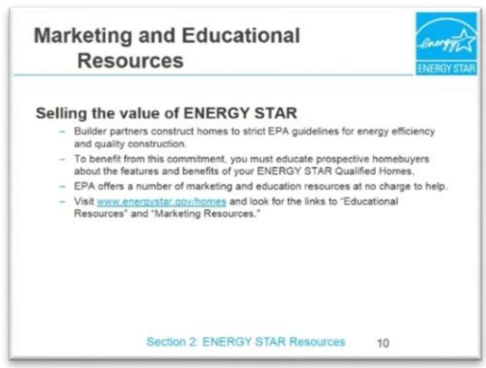
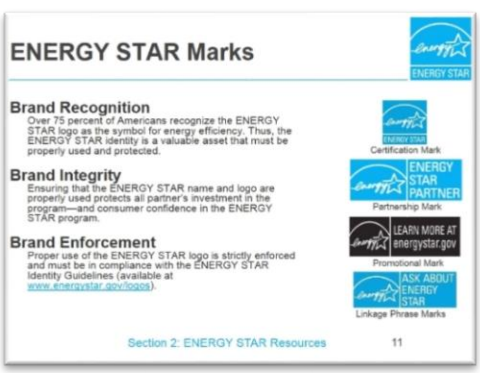










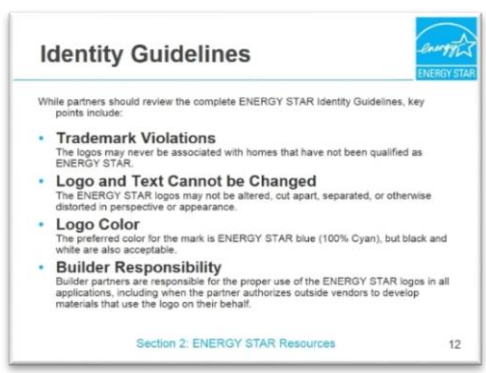
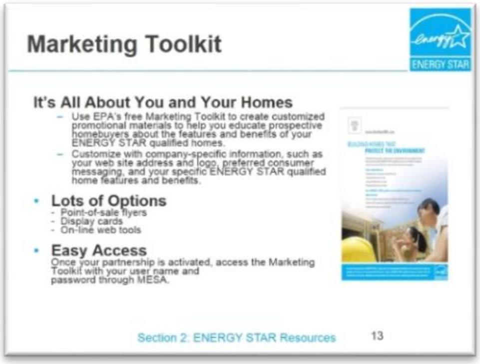
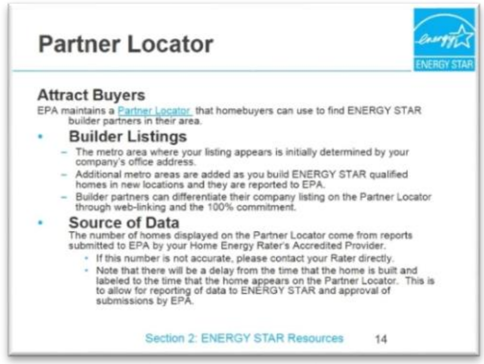
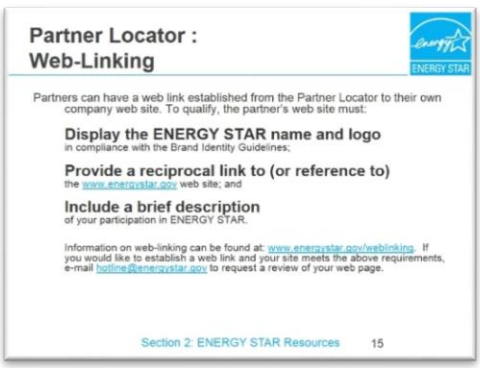


Figure 44: Presentation to SPEER, September 2012 (continued)







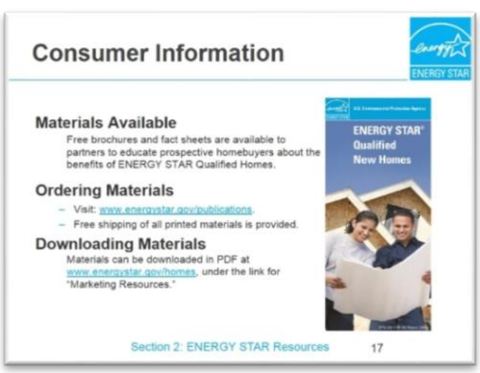
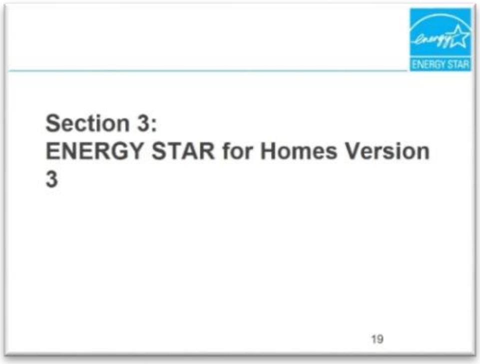
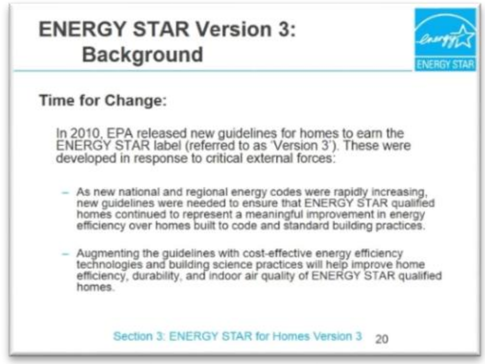
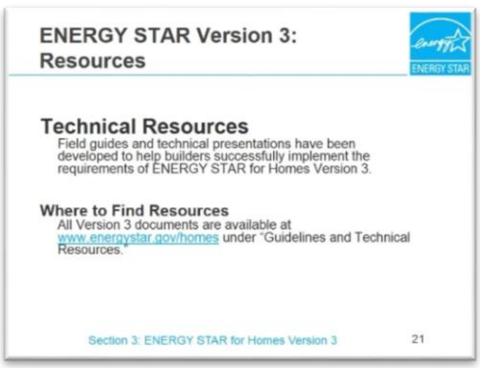
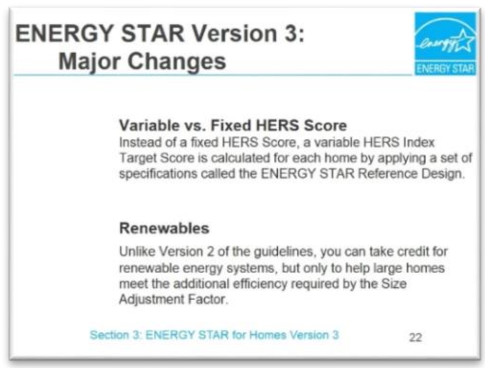


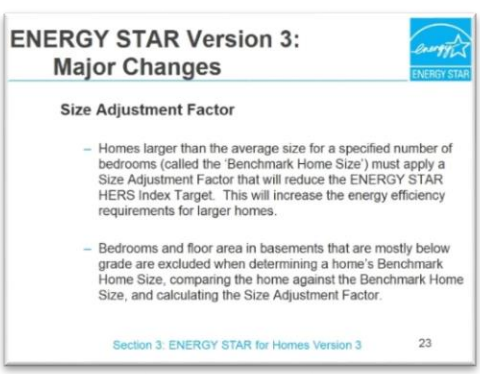
Figure 44: Presentation to SPEER, September 2012 (continued)











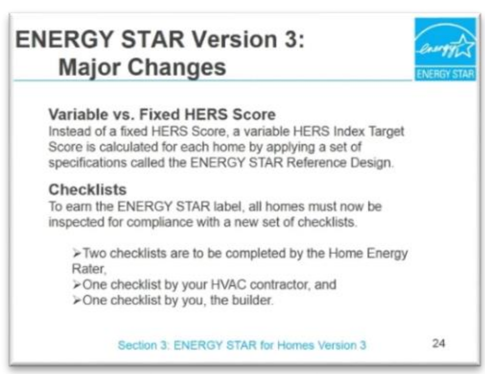
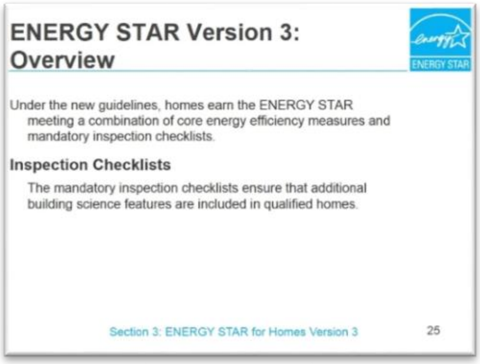
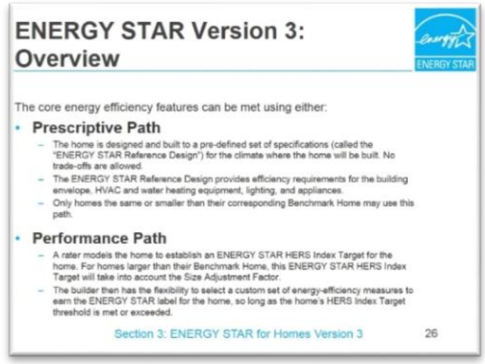
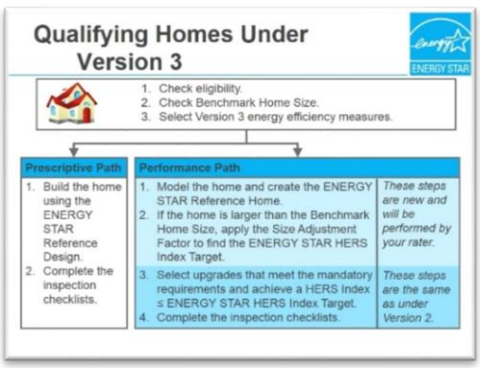
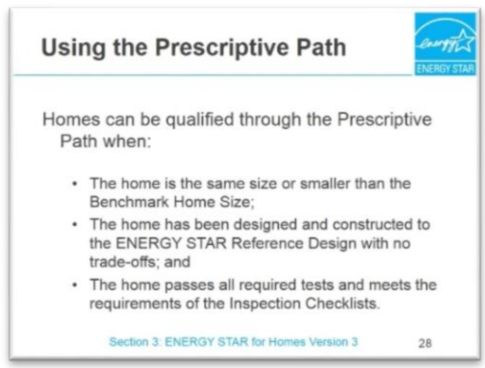


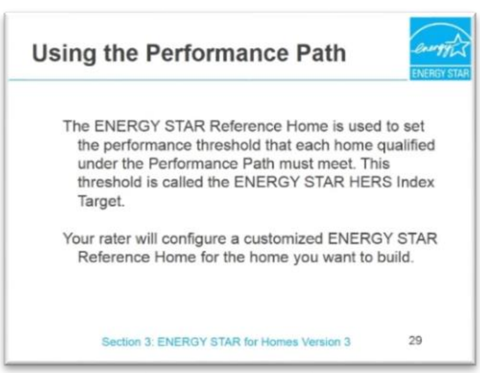
Figure 44: Presentation to SPEER, September 2012 (continued)











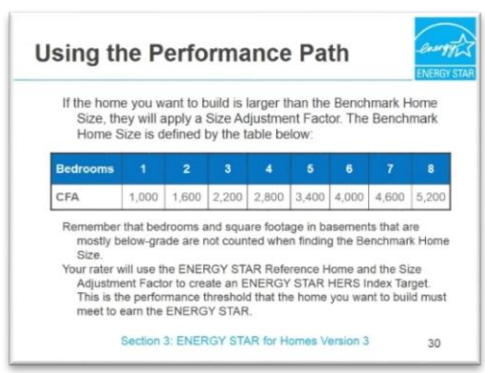
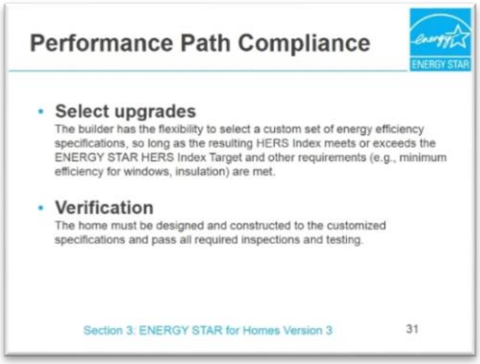
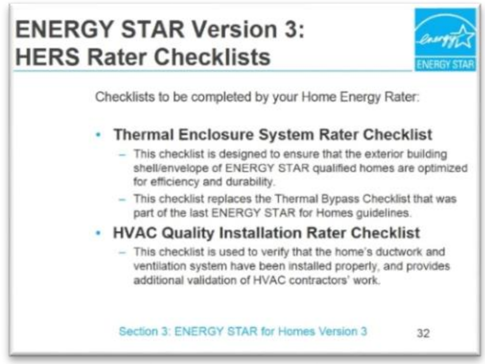
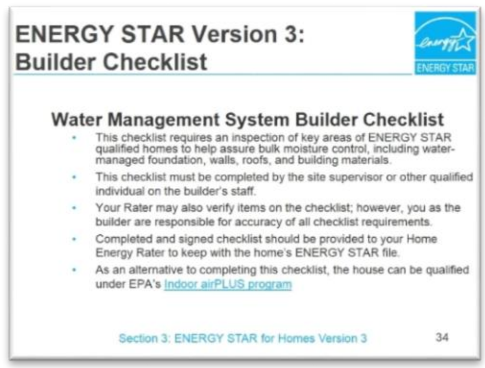
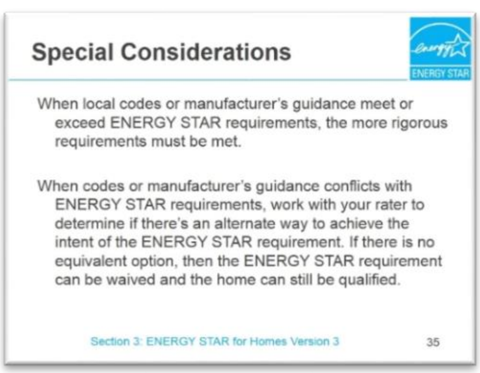


Figure 44: Presentation to SPEER, September 2012 (continued)









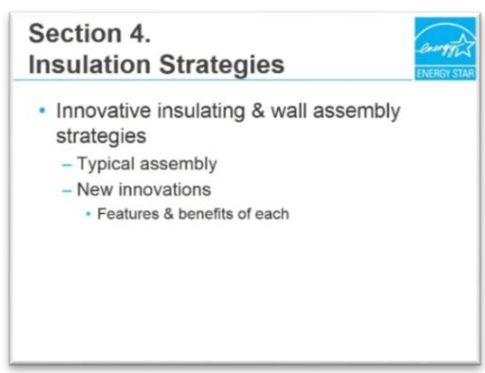
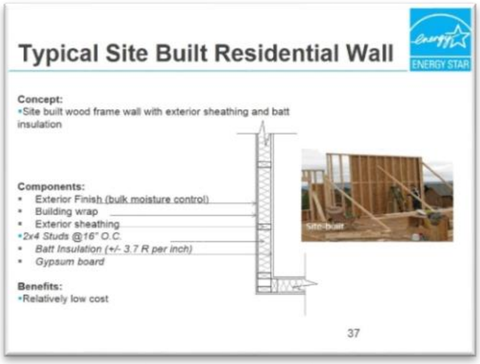
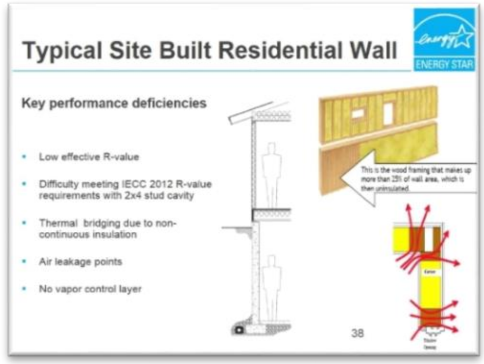
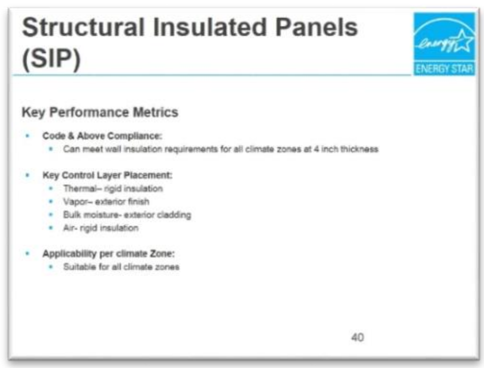
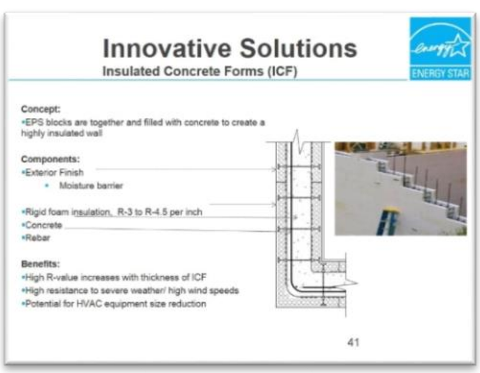


Figure 44: Presentation to SPEER, September 2012 (continued)









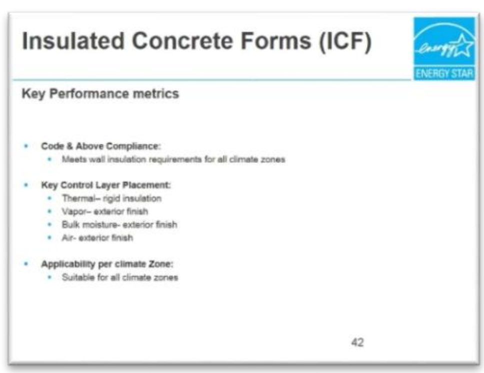
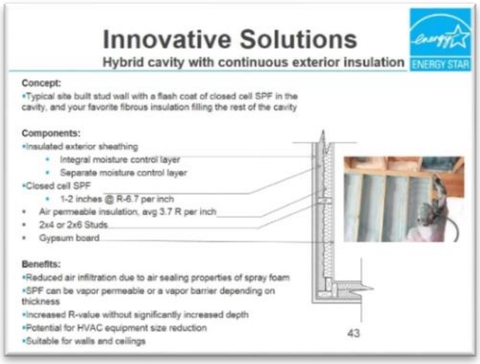
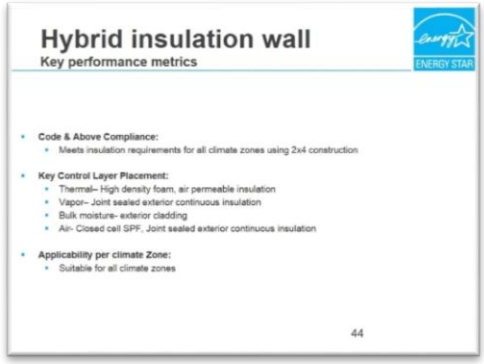
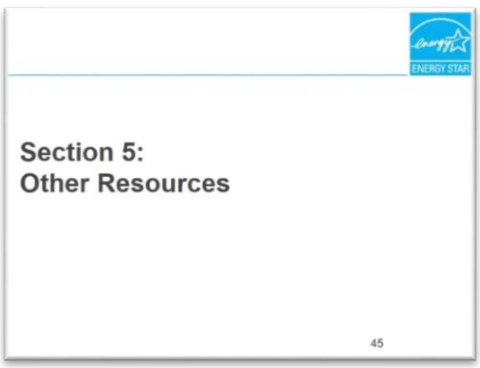
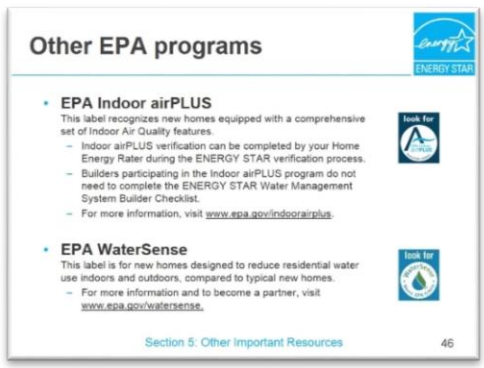


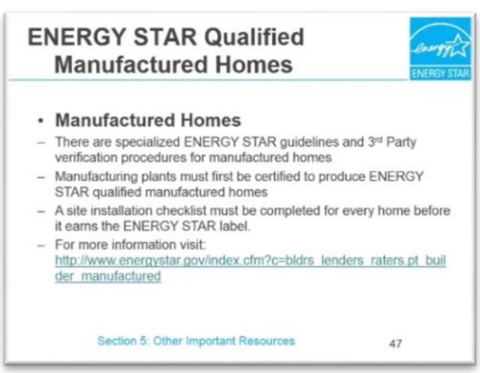
Figure 44: Presentation to SPEER, September 2012 (continued)











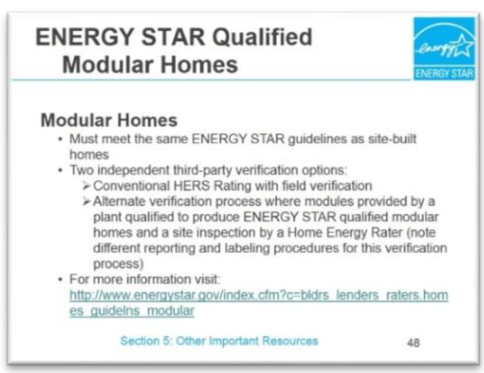


Figure 44: Presentation to SPEER, September 2012 (continued)

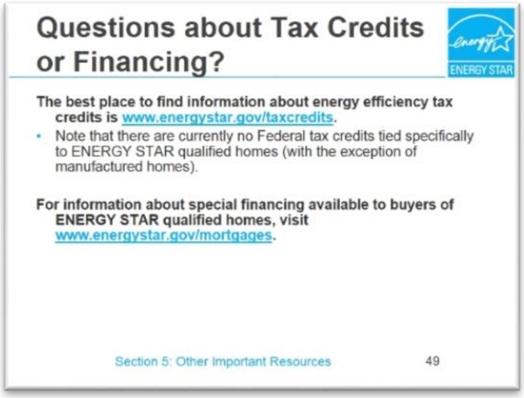
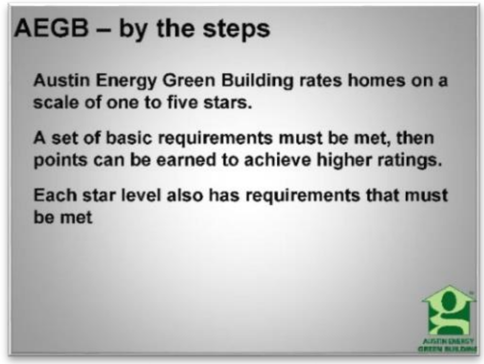
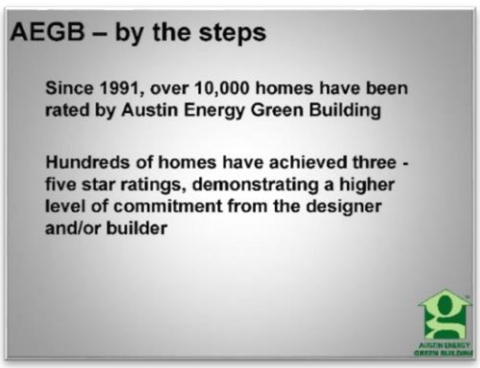
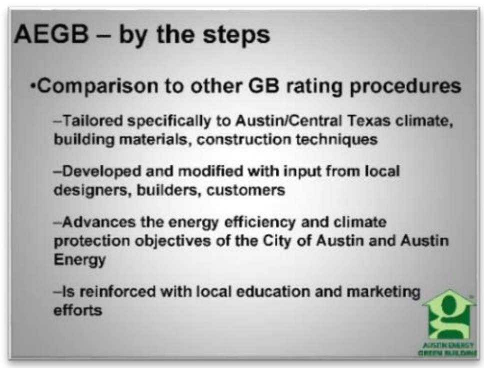


Figure 44: Presentation to SPEER, September 2012 (continued)







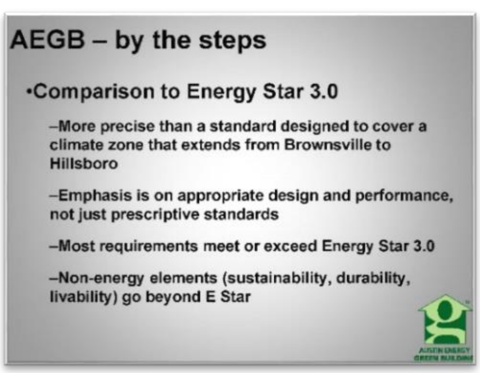
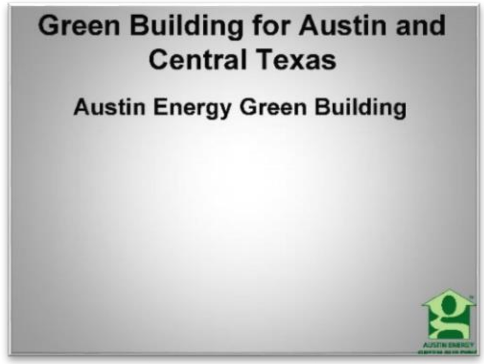


Figure 44: Presentation to SPEER, September 2012 (continued)



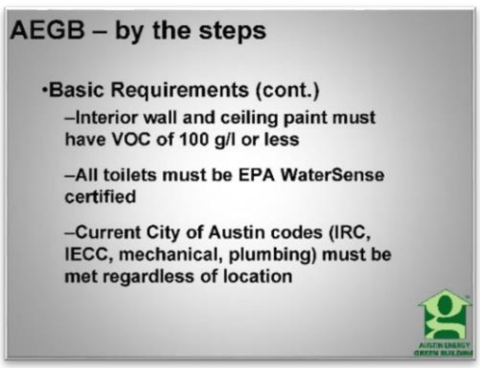


Figure 44: Presentation to SPEER, September 2012 (continued)

Figure 44: Presentation to SPEER, September 2012 (continued)

Figure 44: Presentation to SPEER, September 2012 (continued)

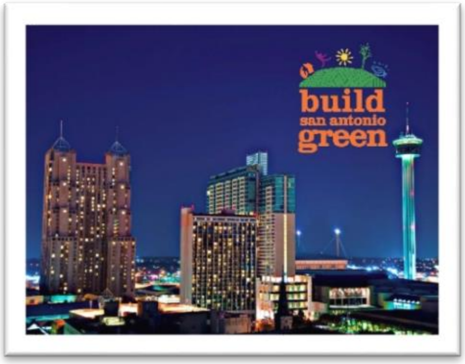
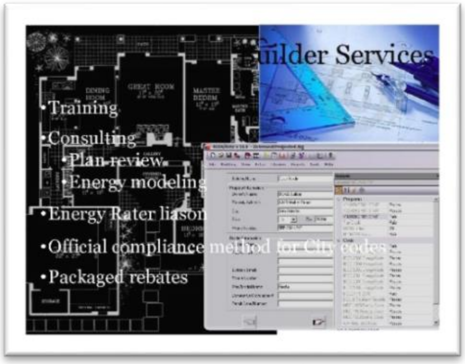
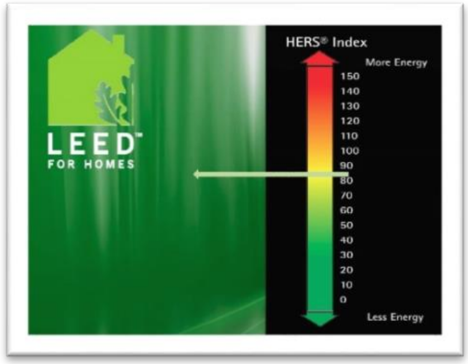
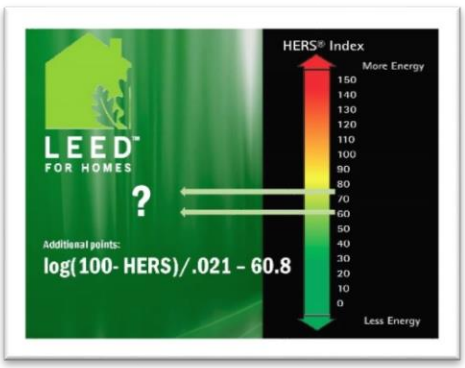


Figure 44: Presentation to SPEER, September 2012 (continued)

Figure 44: Presentation to SPEER, September 2012 (continued)







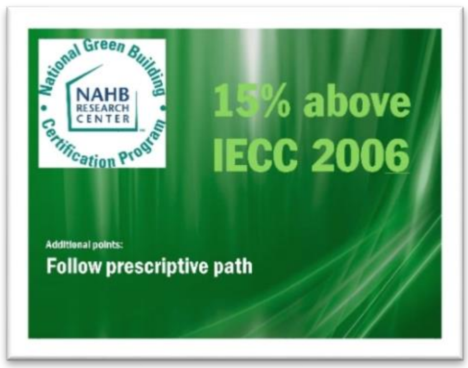


Figure 44: Presentation to SPEER, September 2012 (continued)

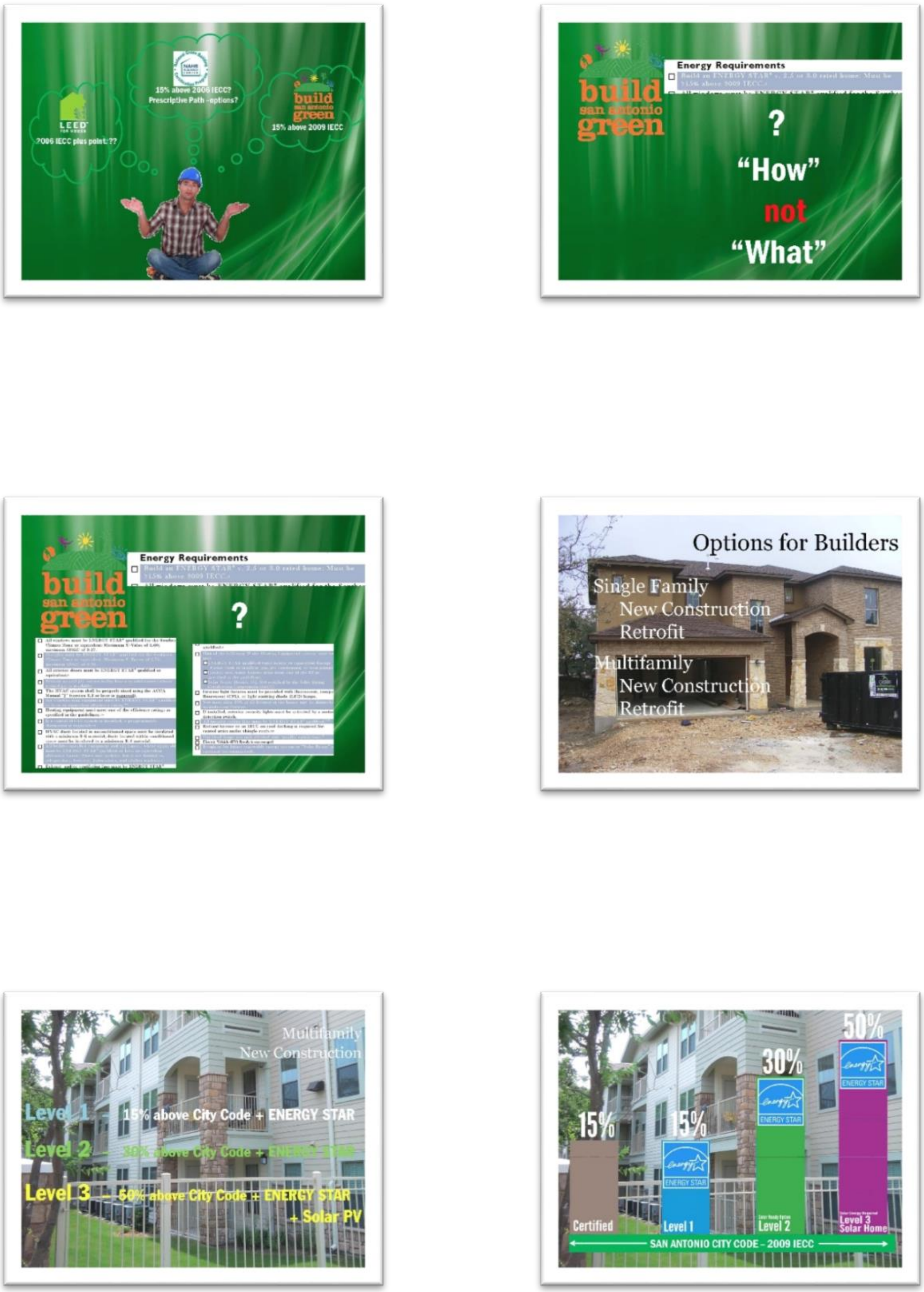


Figure 44: Presentation to SPEER, September 2012 (continued)

Figure 44: Presentation to SPEER, September 2012 (continued)

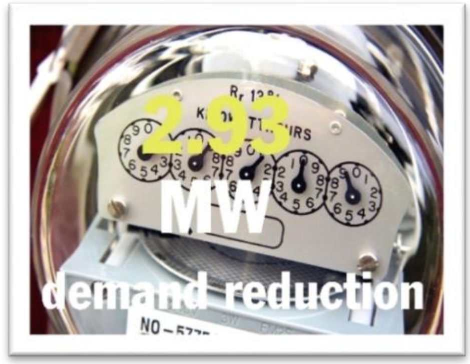
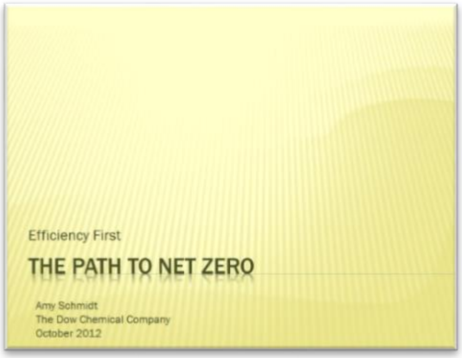
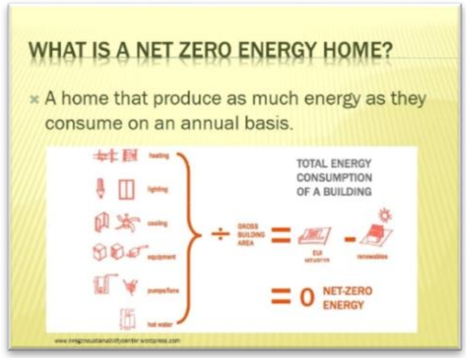
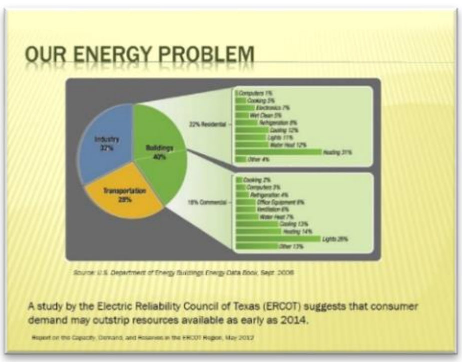


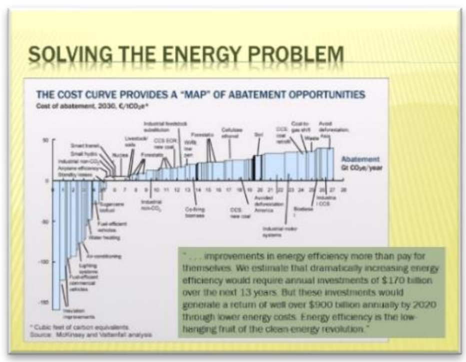
Figure 44: Presentation to SPEER, September 2012 (continued)

Presentation to SPEER, October 2012









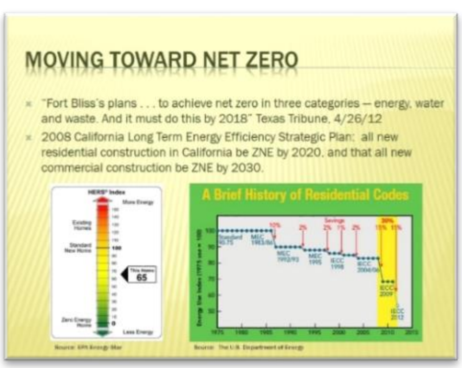
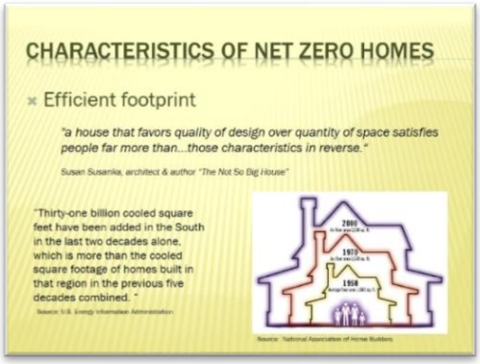
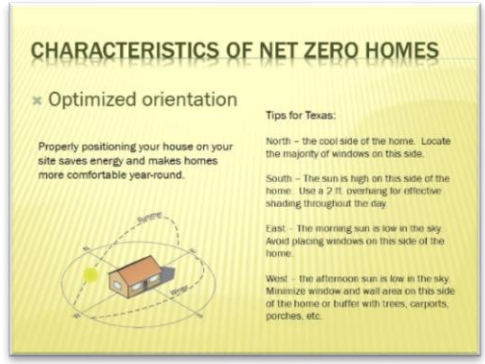
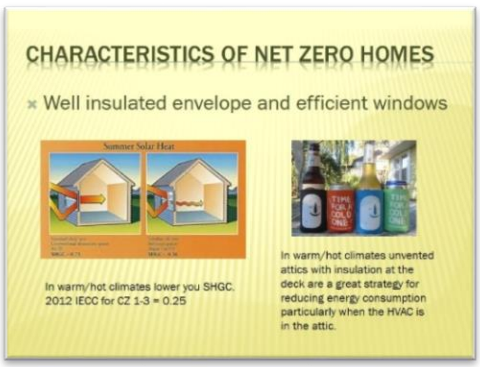
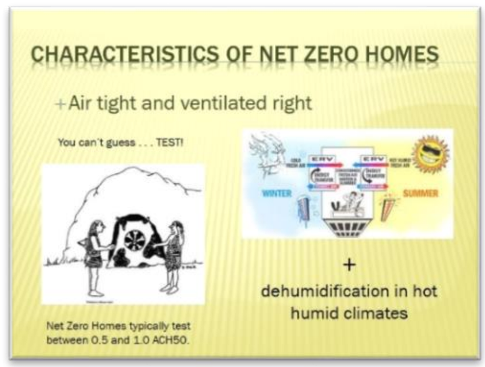


Figure 45: Presentation to SPEER, October 2012 (continued)









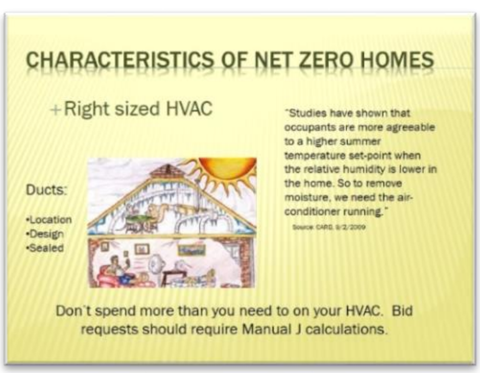
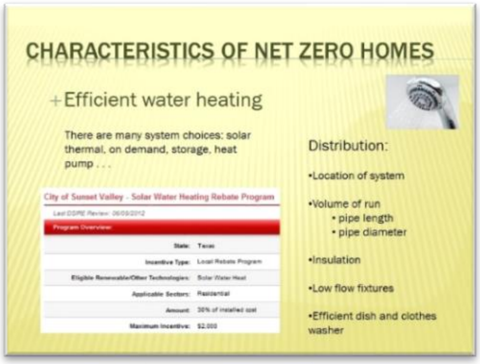
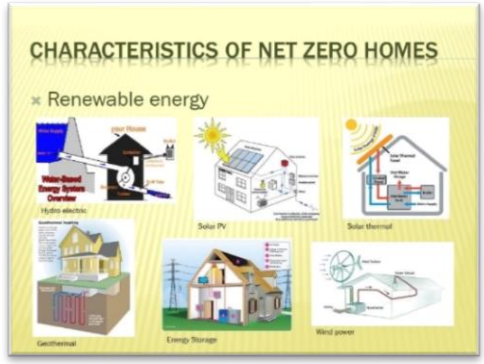
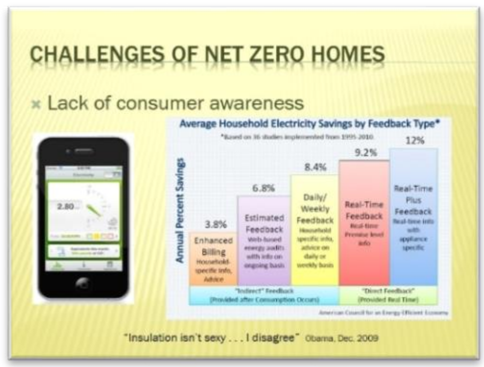
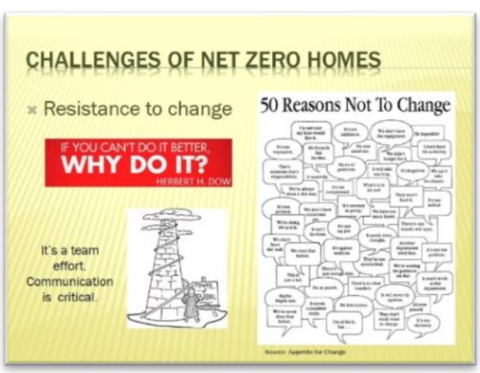


Figure 45: Presentation to SPEER, October 2012 (continued)









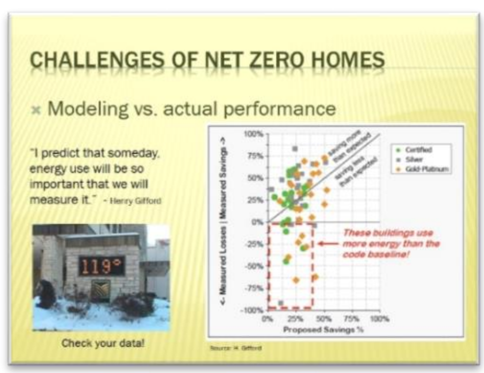
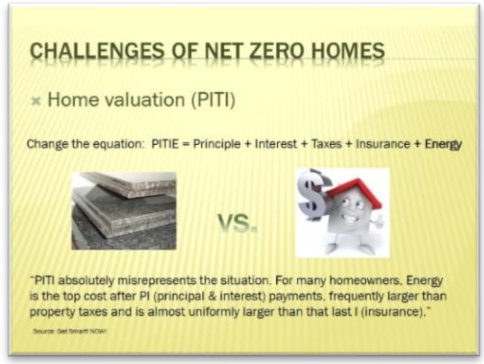
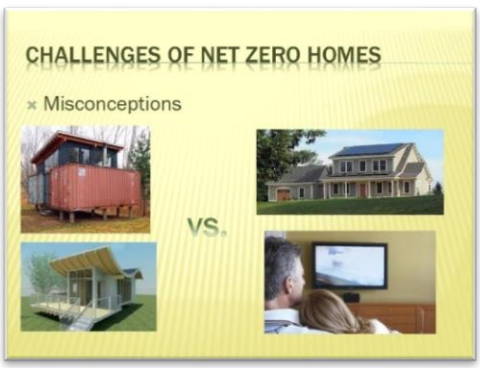
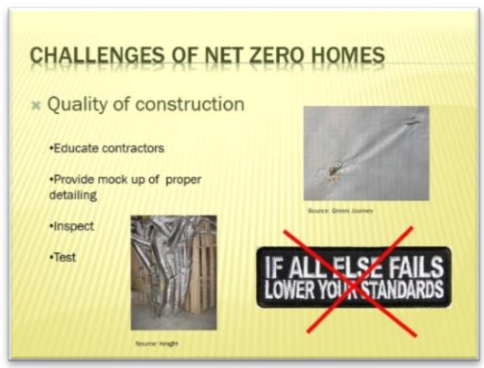


Figure 45: Presentation to SPEER, October 2012 (continued)







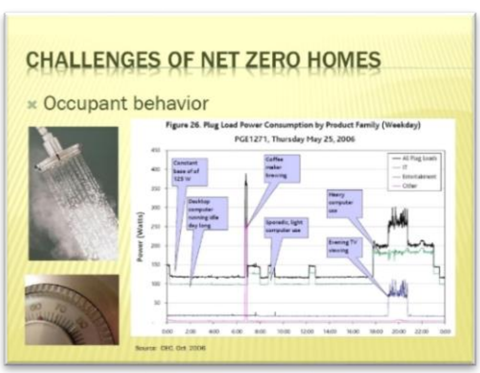
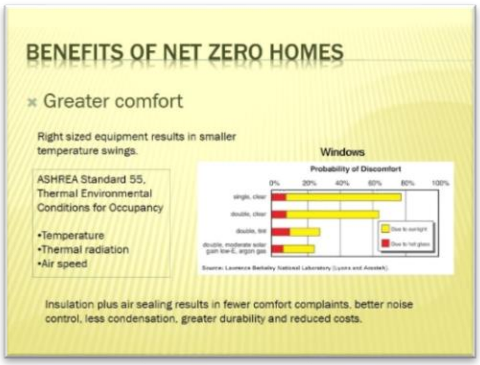
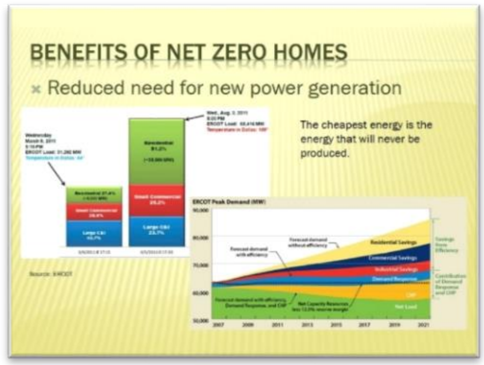
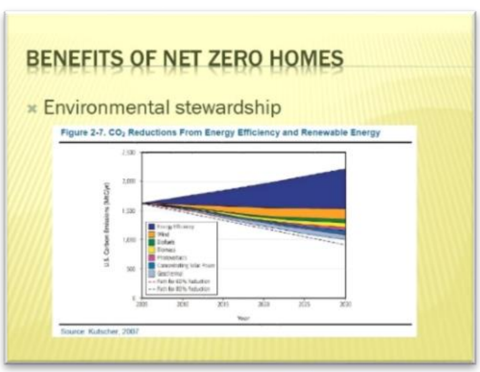


Figure 45: Presentation to SPEER, October 2012 (continued)







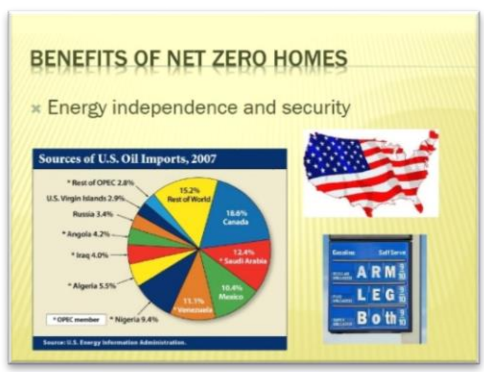
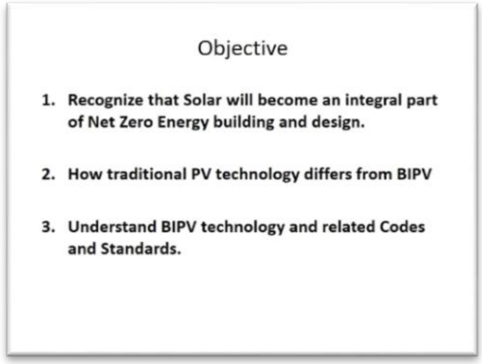


Figure 45: Presentation to SPEER, October 2012 (continued)



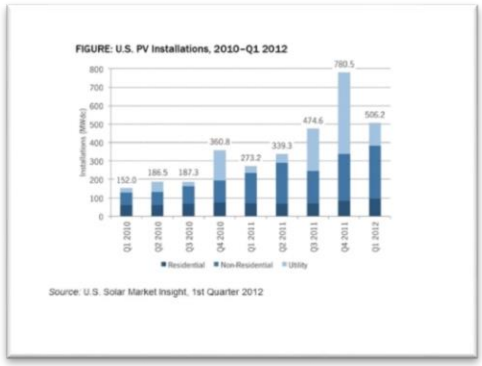


Figure 45: Presentation to SPEER, October 2012 (continued)

BIPV Solution

Source: Solarfeeds.com

Building Integrated Photovoltaic (BIPV)

- Potential for BIPV represents <15% of the total North American residential roofing market
- Historically integrates with high end roofing material: Metal Roofing, Slate and Tile

BIPV Solution

Source: Inhabitat.com

BIPV Solution

Source: Calfinder.com

BIPV Solution

Source: roofinfo.com

BIPV Solution

Source: article.wn.com

Figure 45: Presentation to SPEER, October 2012 (continued)

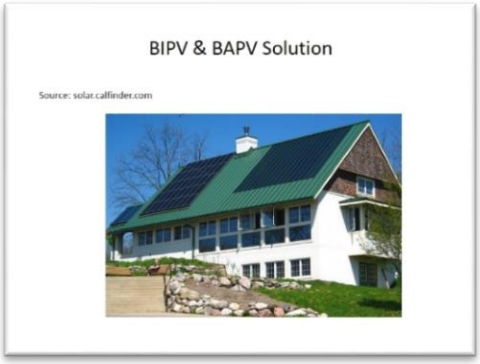
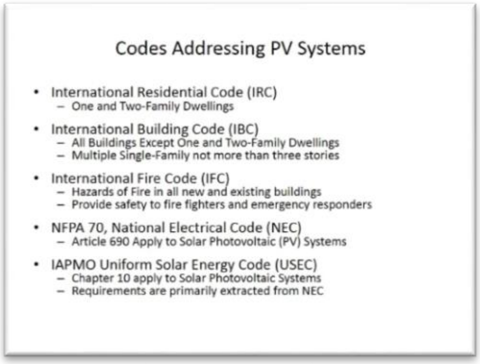
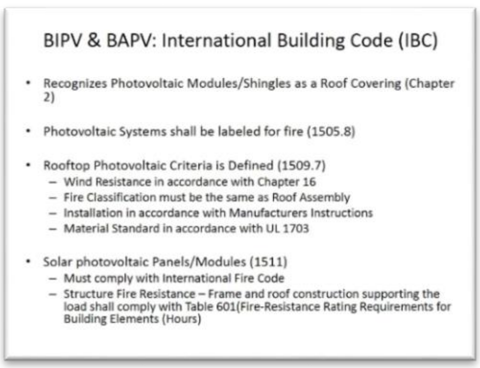


Figure 45: Presentation to SPEER, October 2012 (continued)

Figure 45: Presentation to SPEER, October 2012 (continued)





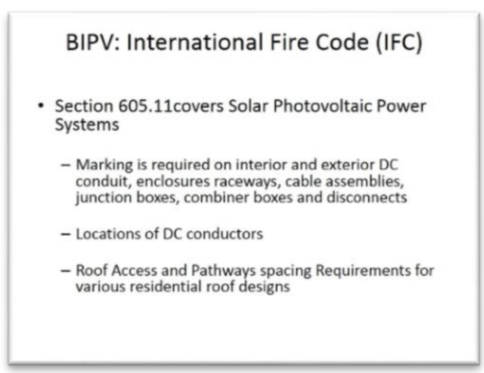
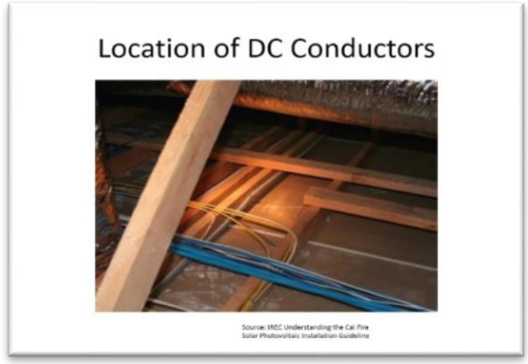
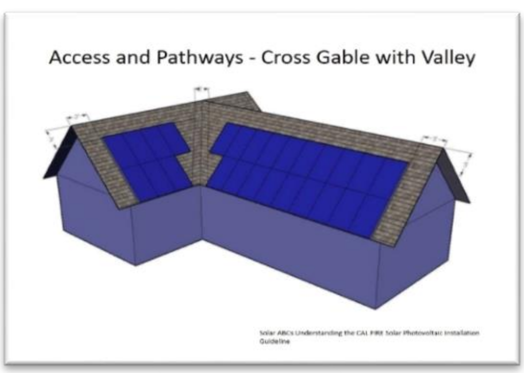


Figure 45: Presentation to SPEER, October 2012 (continued)





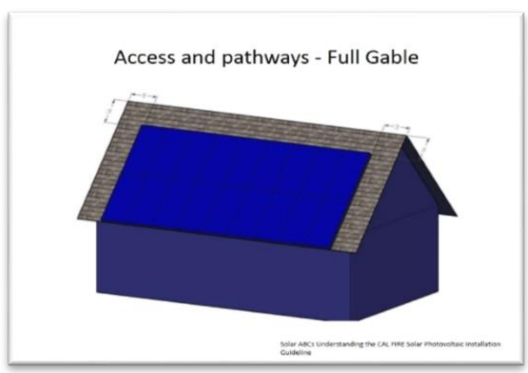
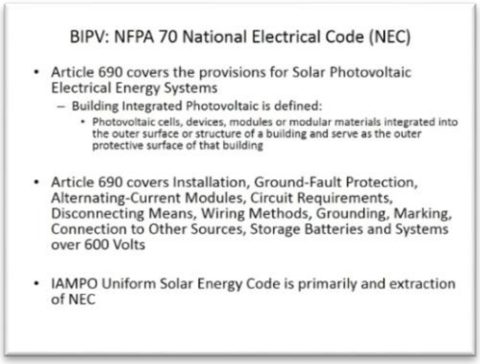
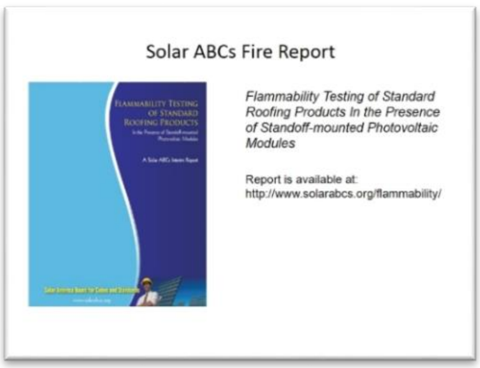


Figure 45: Presentation to SPEER, October 2012 (continued)





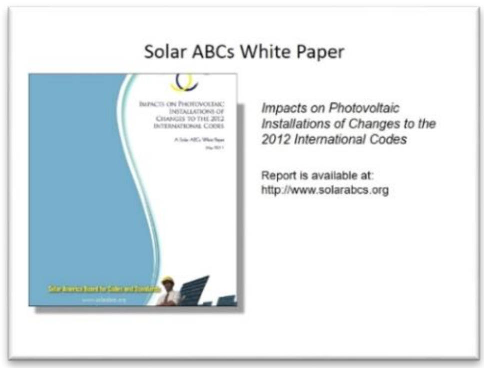


Figure 45: Presentation to SPEER, October 2012 (continued)

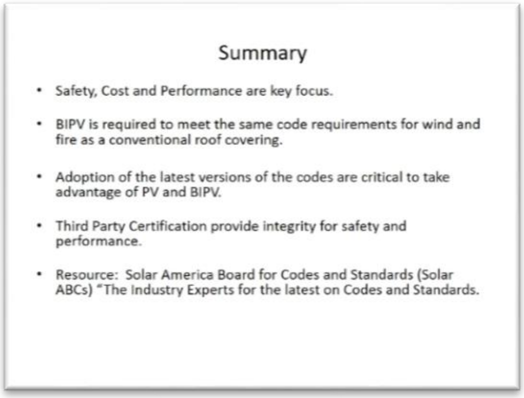
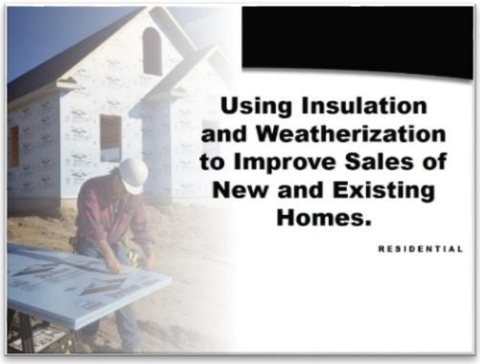


Figure 45: Presentation to SPEER, October 2012 (continued)



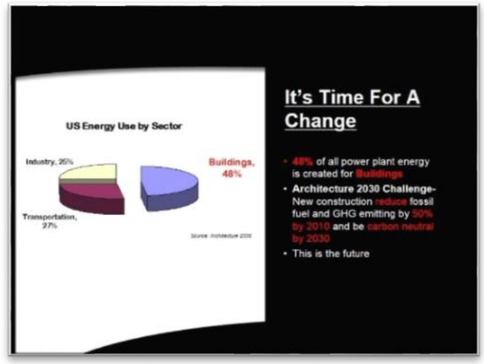
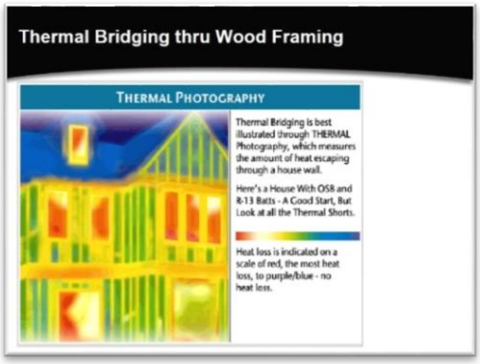
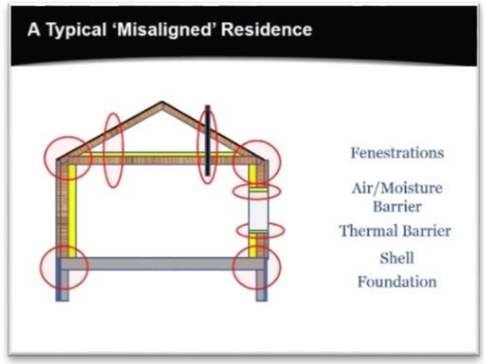
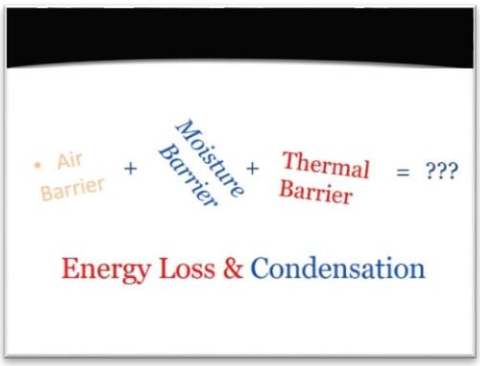
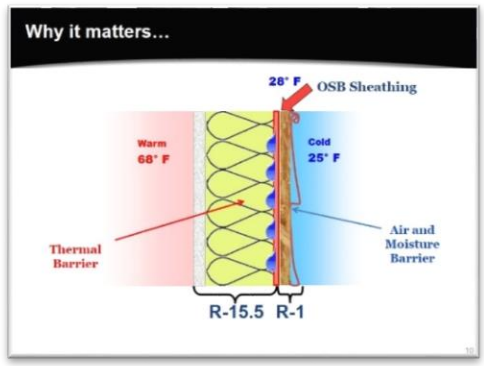


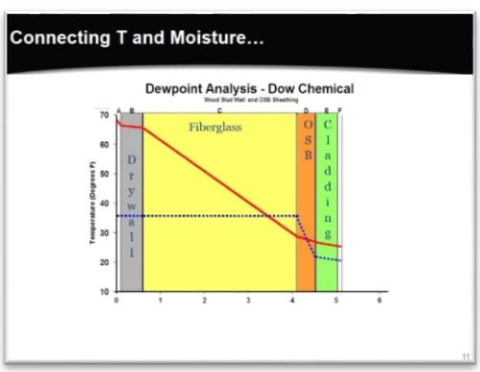
Figure 45: Presentation to SPEER, October 2012 (continued)











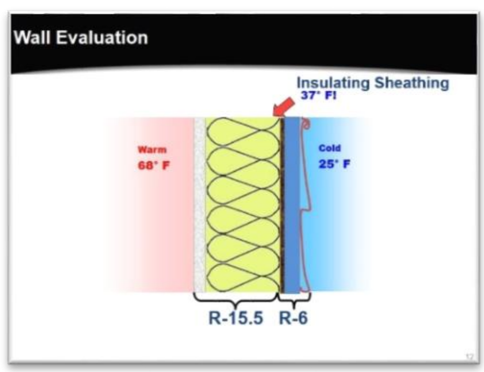
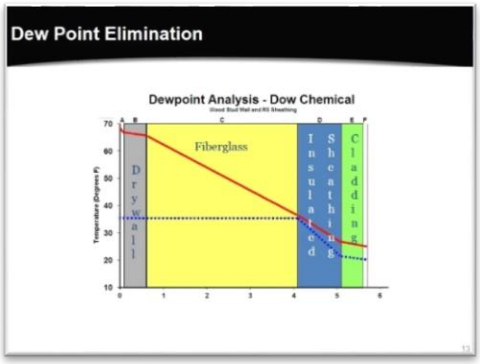
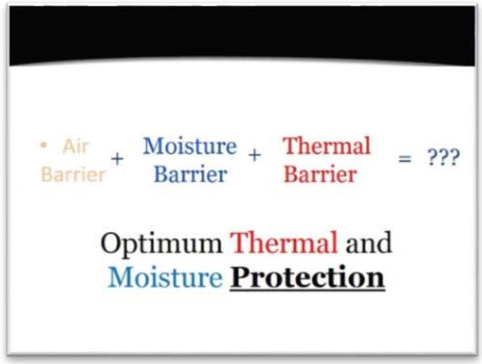


Figure 45: Presentation to SPEER, October 2012 (continued)





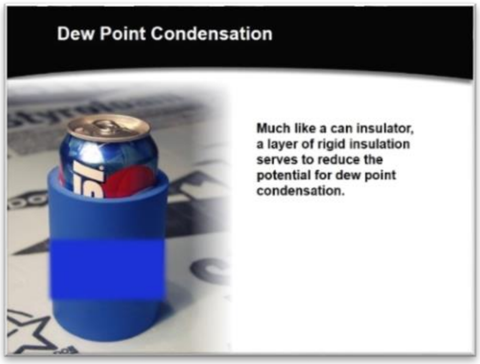
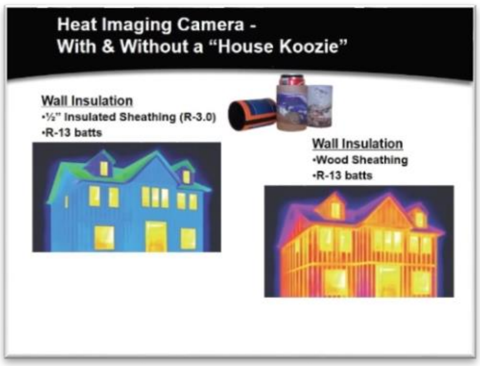
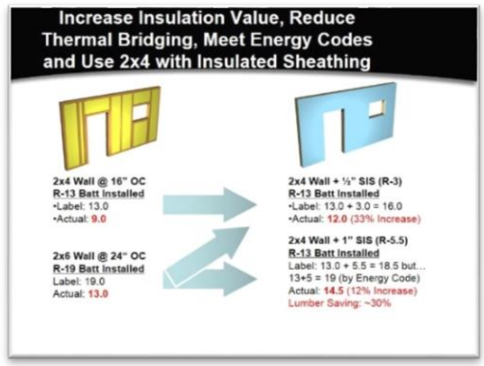
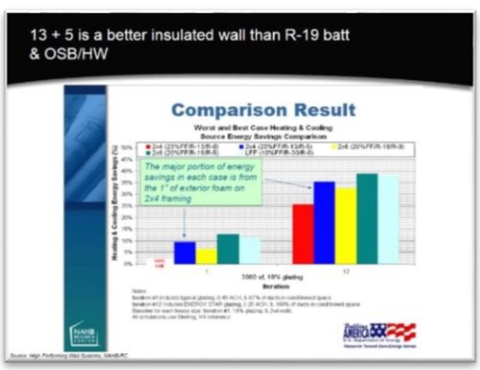


Figure 45: Presentation to SPEER, October 2012 (continued)







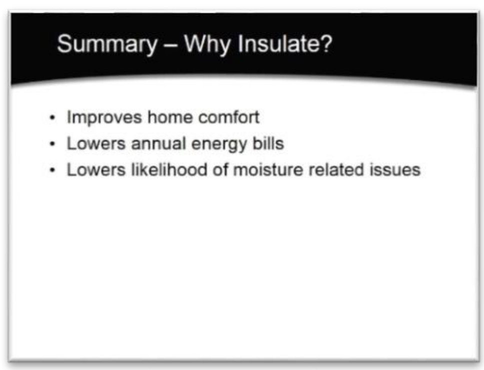
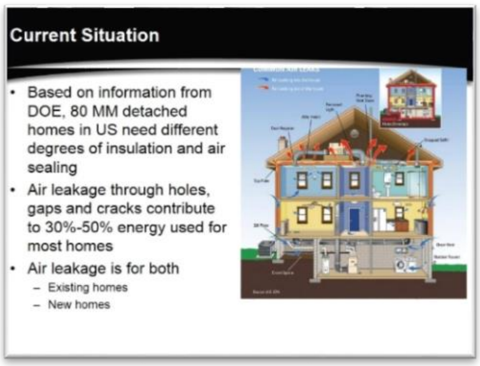
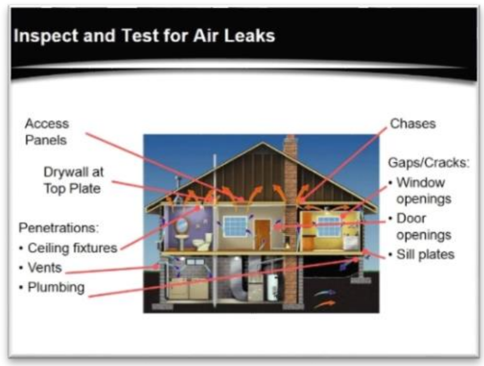


Figure 45: Presentation to SPEER, October 2012 (continued)





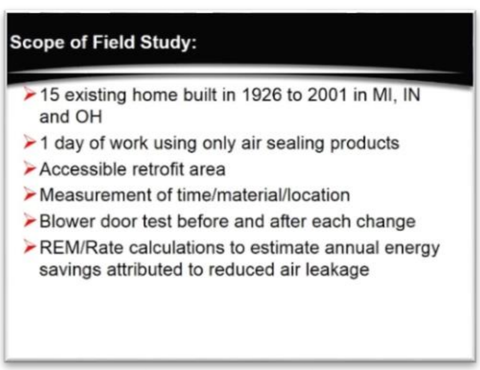
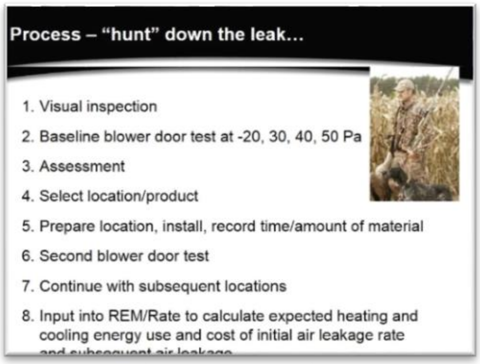
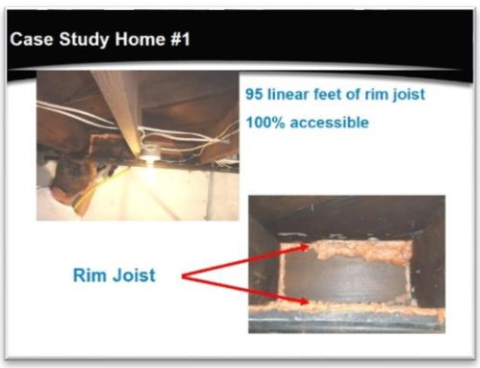
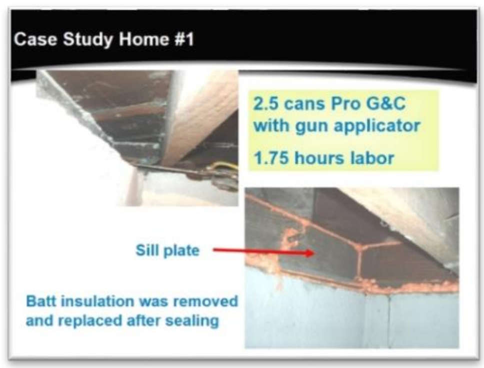


Figure 45: Presentation to SPEER, October 2012 (continued)







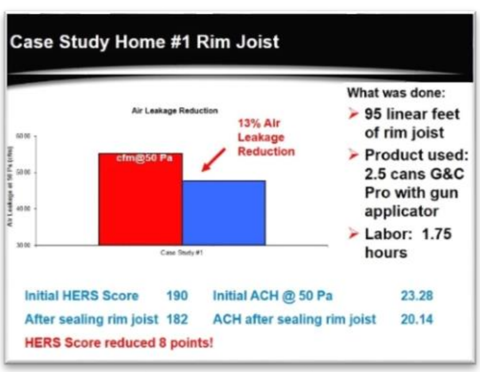
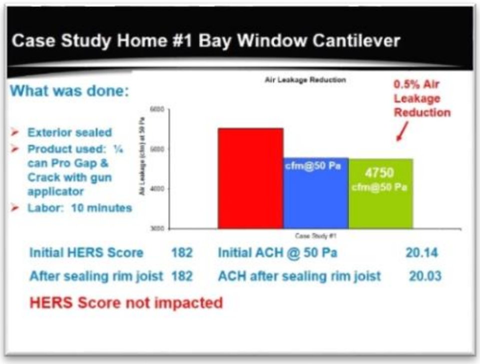
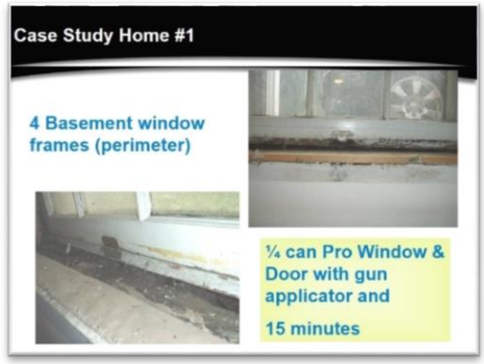
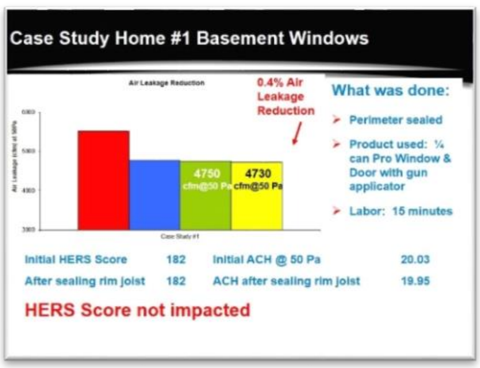
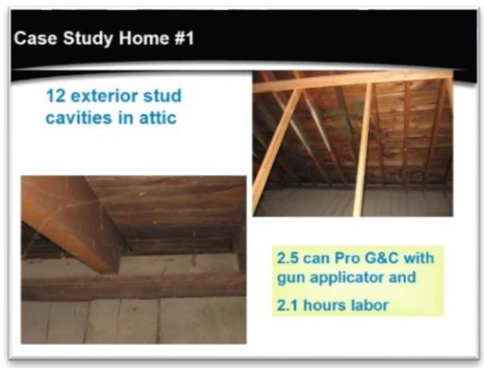


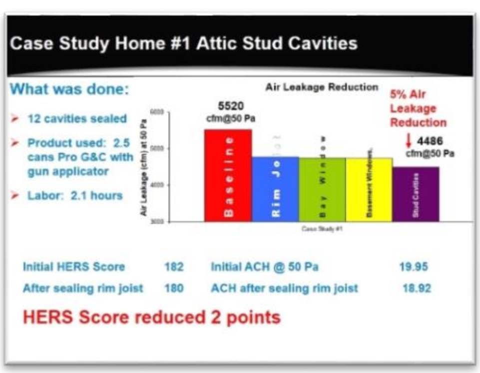
Figure 45: Presentation to SPEER, October 2012 (continued)











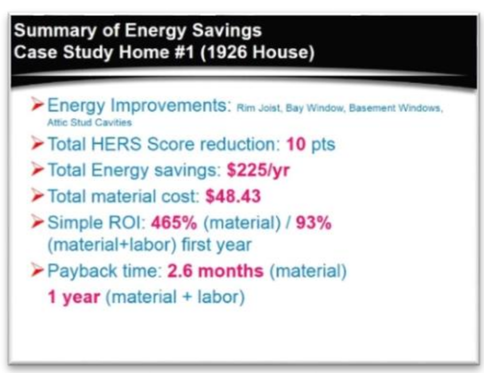


Figure 45: Presentation to SPEER, October 2012 (continued)

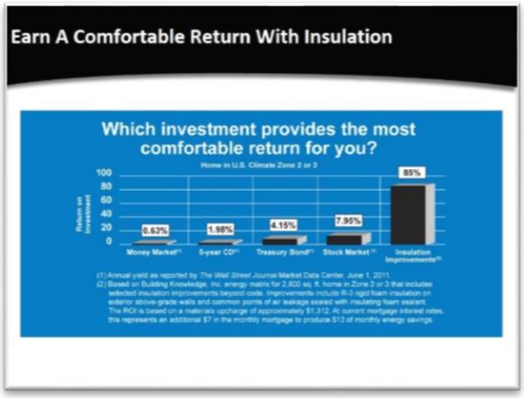
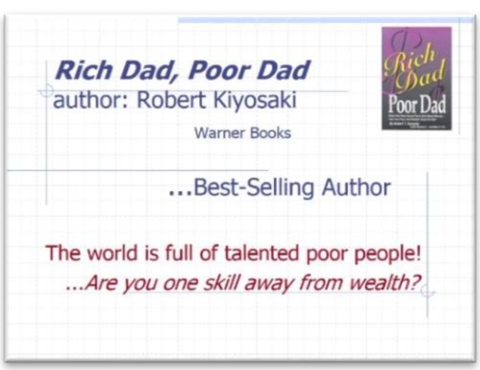


Figure 45: Presentation to SPEER, October 2012 (continued)



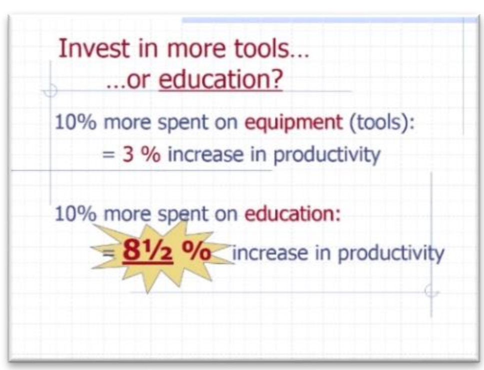
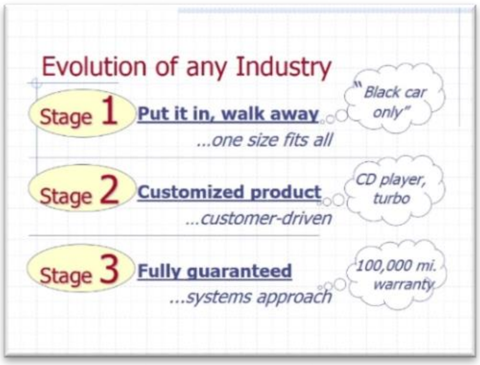


Figure 45: Presentation to SPEER, October 2012 (continued)



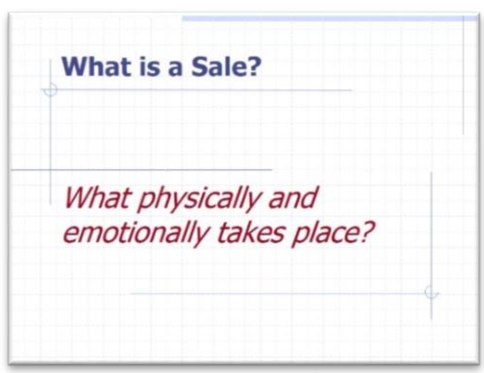


Figure 45: Presentation to SPEER, October 2012 (continued)

Sale: **A *transfer* of *feelings* !**

Feelings Transferred:

- ***Professionalism***
- ***Value*** *(not "quality")*
- ***Enthusiasm***
- ***Confidence*** *

(knowledge and experience)

What Don't You Sell?

- You don't sell energy efficiency!
- Efficiency is a logical attribute- no sizzle
- People make ALL decisions based on emotion – Yes, that includes you!
- Recent scientific research confirms that decisions are made in the emotional center of the brain and then in milliseconds, the brain asks the logical side to find a sound justification for the decision

What *do* you sell?

We sell *perceptions...*

justified by logic!

Comfort	Appearance	Safety
Security	Convenience	Health
Appeal	Life Style	Status
Fashion	Success	Value
Leisure	Efficiency	Durability
Environment	Peace of Mind	*...and more*

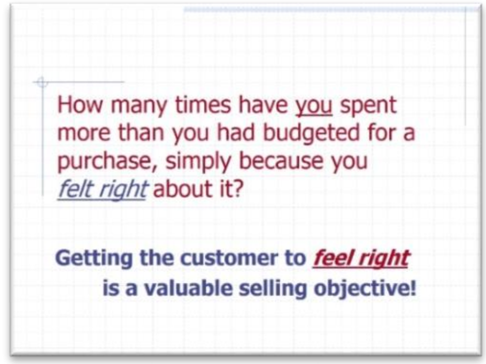
What Do You Sell?

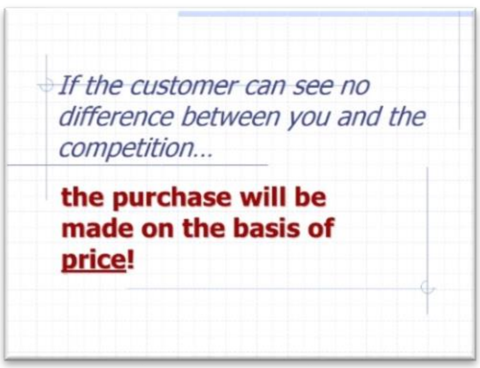
- You Sell the Emotionally Loaded Values
- Then, when you have them wanting the comfort, health, low maintenance durability, social prestige, etc
- Then you give them a sound and undeniably logical justification to validate their emotional decision – Efficiency, ROI, based in good dollars and sense reasoning!

Brad Mann, owner of Comfort First Heating and Cooling in Lansing, Michigan, has embraced home-performance since 2004 and says in Home Energy Magazine:

- **"The Message Is Comfort"**
- "One of this industry's biggest problems is thinking that everyone really cares about saving the planet," said Mann. With very few exceptions, "the average homeowner couldn't care less . They care more about helping their asthma or being more comfortable."

Figure 45: Presentation to SPEER, October 2012 (continued)





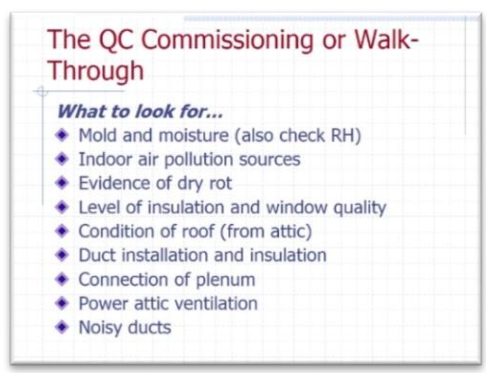


Figure 45: Presentation to SPEER, October 2012 (continued)

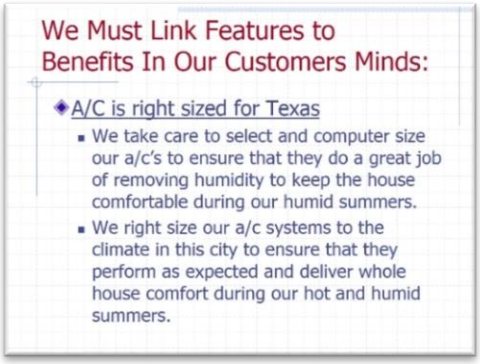


Figure 45: Presentation to SPEER, October 2012 (continued)

We Must Link Features to Benefits In Our Customers Minds:

- Pressure Tested to be More Comfortable:
  - We test our homes under pressure using a scientifically designed fan to be sure that we've fund and sealed the cold and hot drafts so that your home will be comfortable throughout the year.
  - Our homes are tested to keep pollen and dust out and they have a mechanical ventilation system to breath in fresh filtered air for your health every hour of every day.

We Must Link Features to Benefits In Our Customers Minds:

- You can tag each of these feature/benefit statements with:
- "And that's not all, the sum total of all of these improvements is lasting value and a high performance house system that's energy efficient which keeps more of your family's hard earned dollars in your pocket every month."

Cool Tools for Testing and Planting Flags!

Blower Door
...for duct leakage, infiltration, pressure boundary

Digital Manometer
...duct leaks, pressure mapping, back-drafting/flue draft

Moisture Meter
...to locate leaks, identify hidden moisture/mold (not dry air sources)

MORE Cool Tools...

CO Tester
...for appliance safety, flue backdraft, CO exposure (not smoke alarm testing)

Flow Hood
...air balancing, identifying causes of airflow-related discomfort

Smoke Puffer
...customers love it!

Duct Pressurization Tester (blaster)
...to quantify duct leakage

Getting the ***Order...***

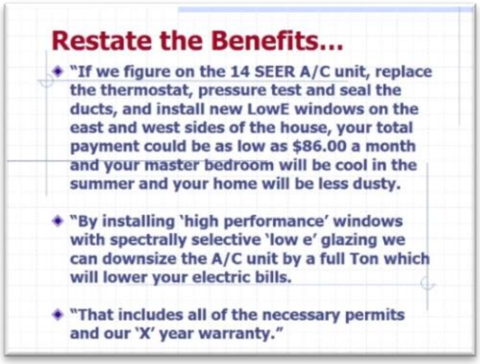
Eye contact is absolutely crucial!

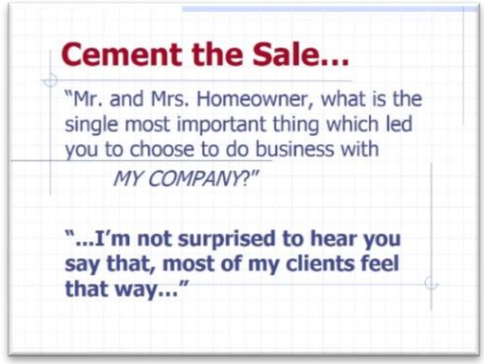
If you're not going to use eye contact, you might as well FedEx your presentation!

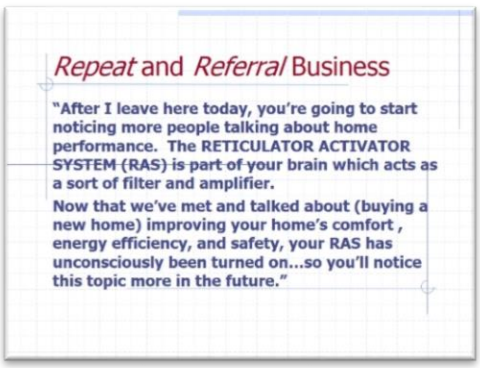
Tell your prospect...

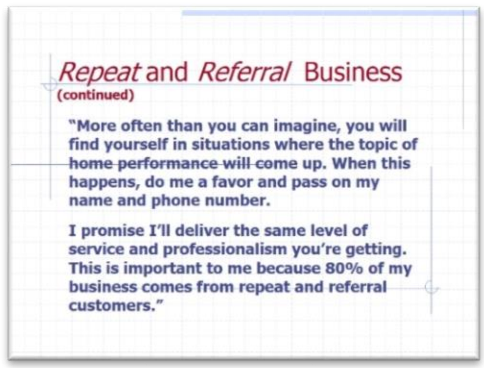
- ***what their special needs are***
- ***what makes you different from the competition***
- ***what unique benefit they derive from your service***

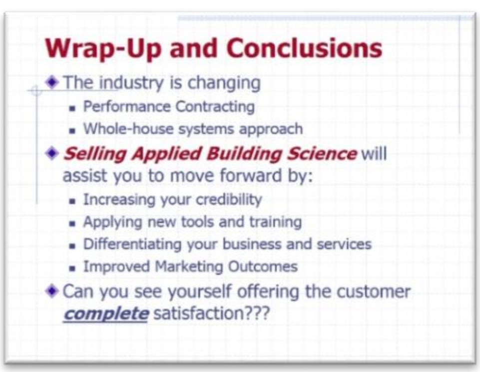
Figure 45: Presentation to SPEER, October 2012 (continued)











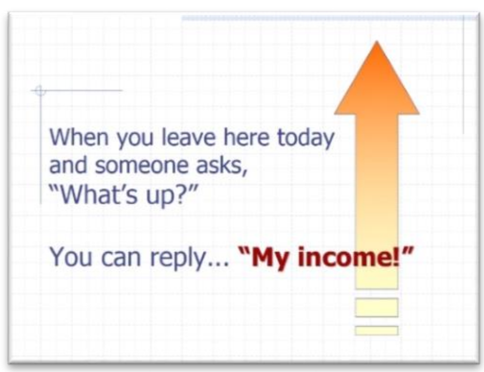
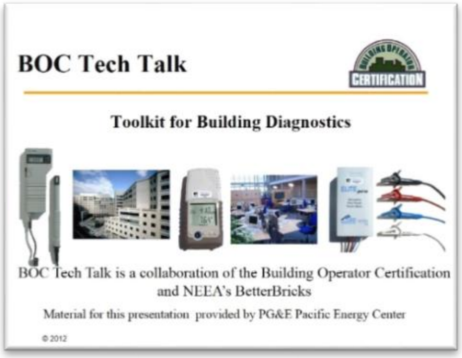
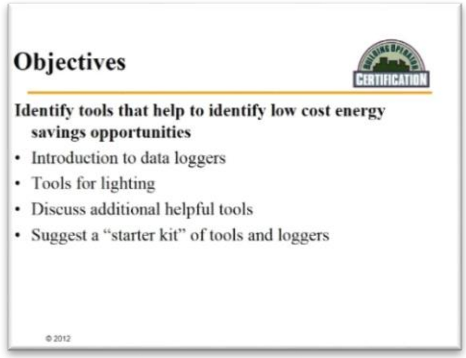


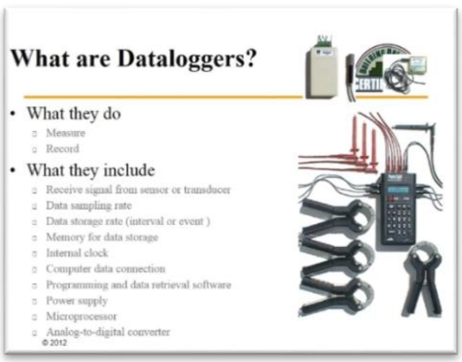
Figure 45: Presentation to SPEER, October 2012 (continued)

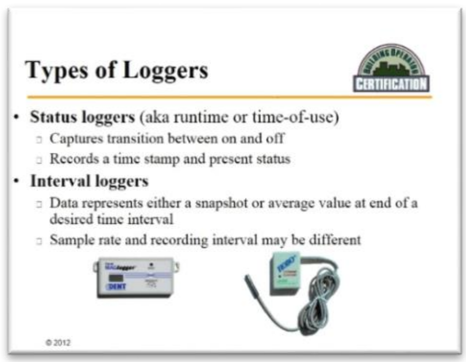
Figure 45: Presentation to SPEER, October 2012 (continued)

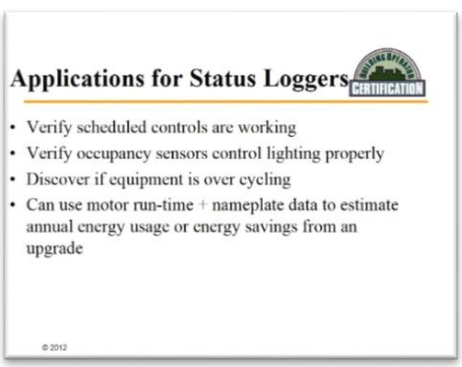
Presentation to SPEER, December 2012











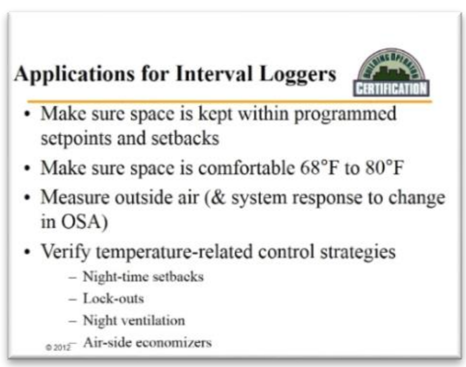
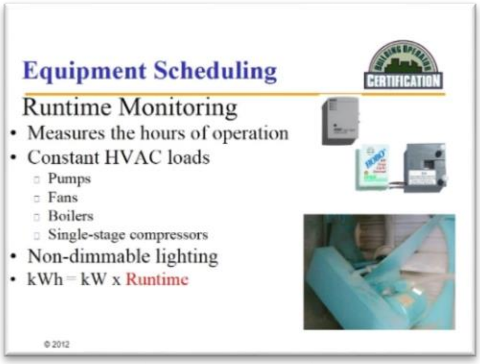
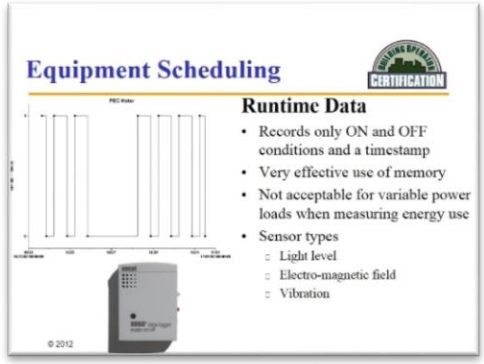
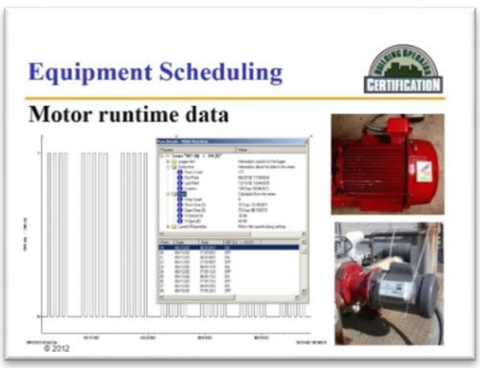
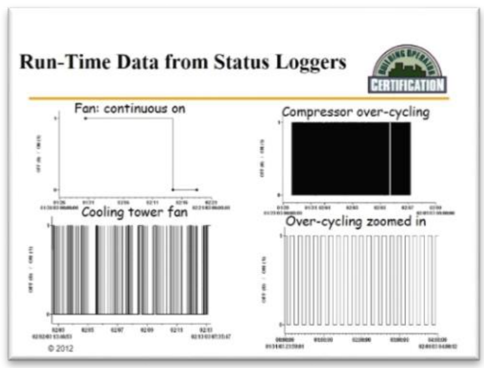


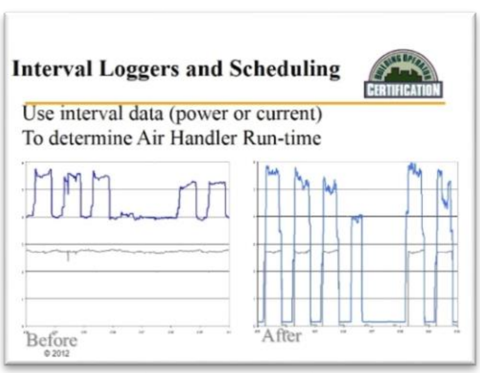
Figure 46: Presentation to SPEER, December 2012











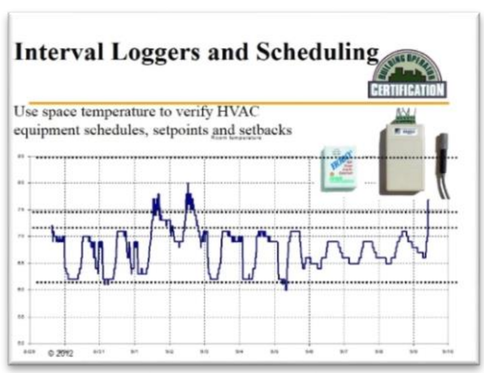
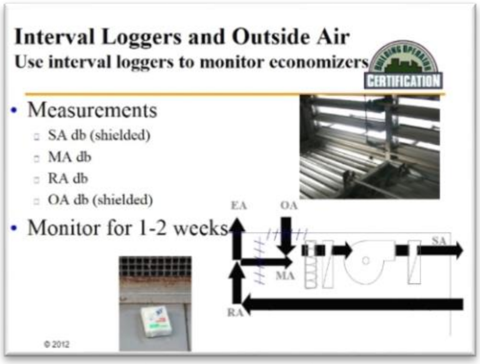
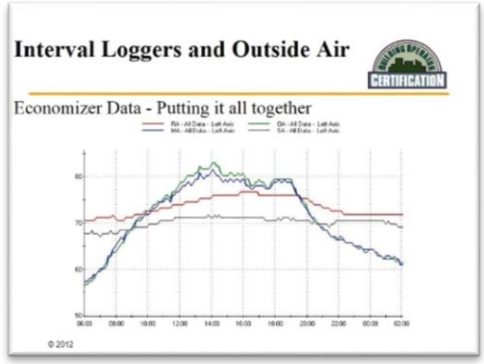
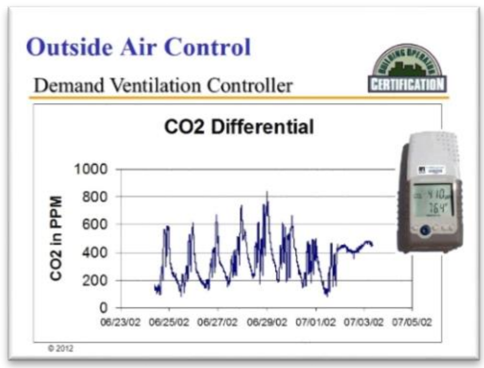
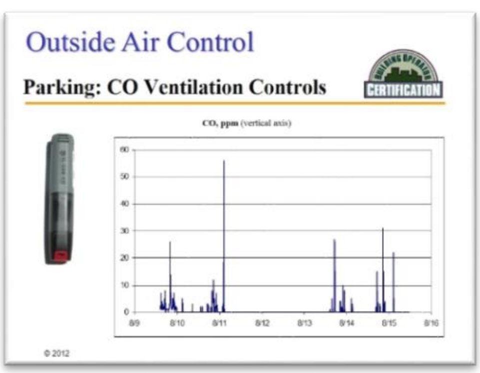


Figure 46: Presentation to SPEER, December 2012 (continued)









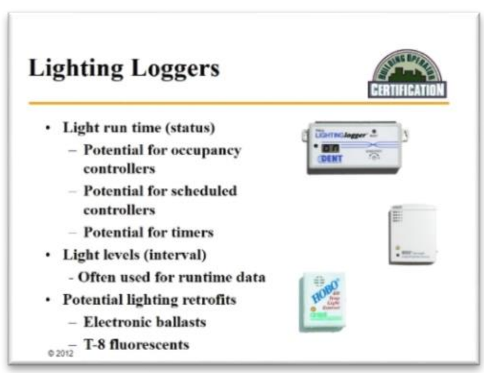
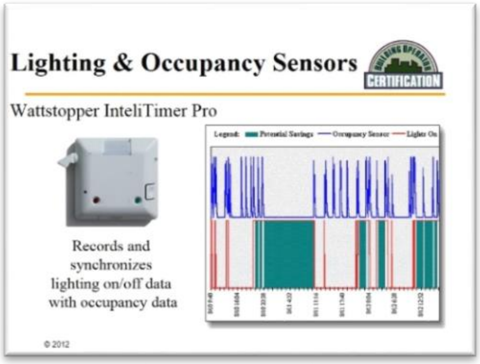
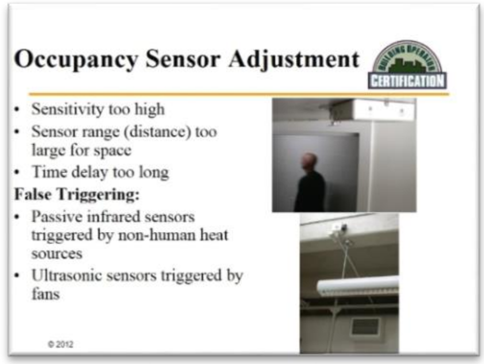
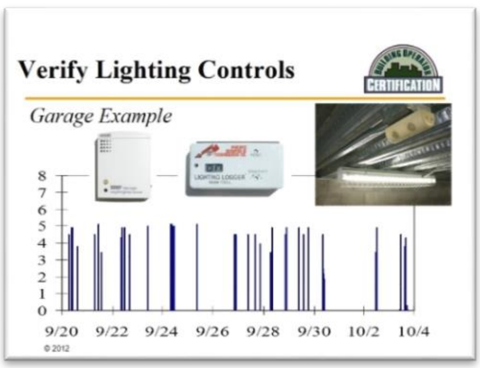
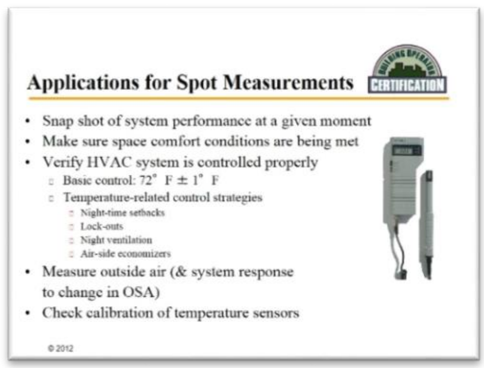


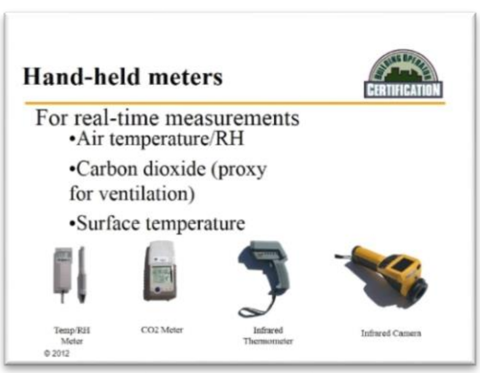
Figure 46: Presentation to SPEER, December 2012 (continued)











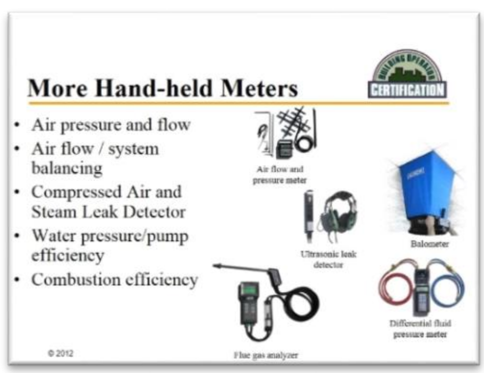
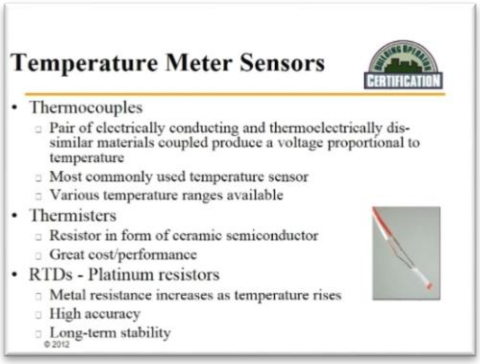
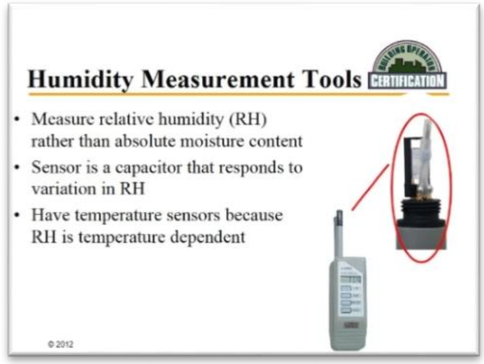
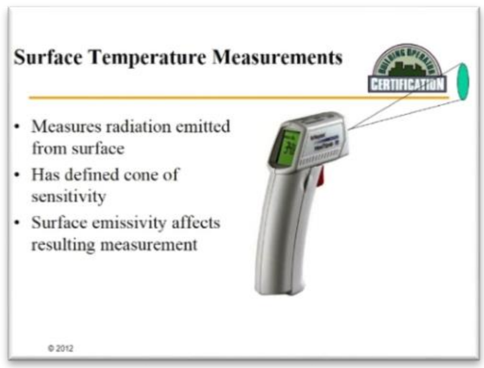
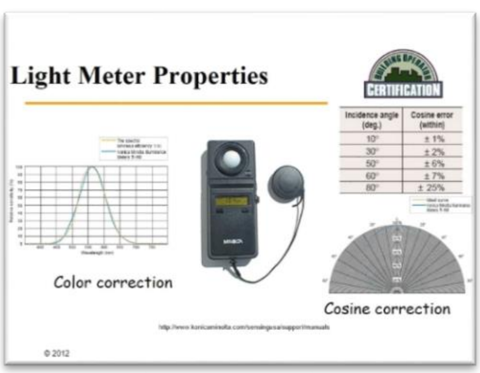


Figure 46: Presentation to SPEER, December 2012 (continued)









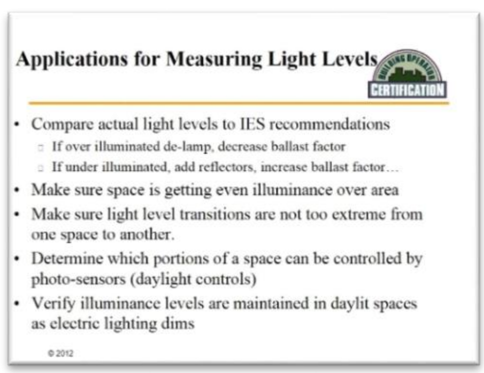
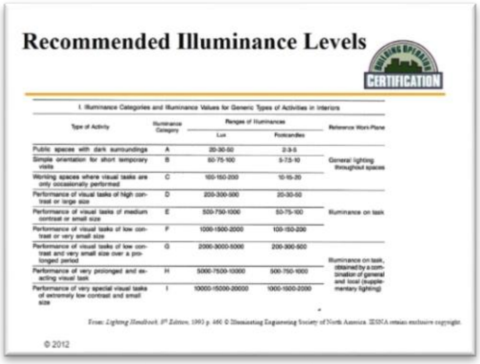
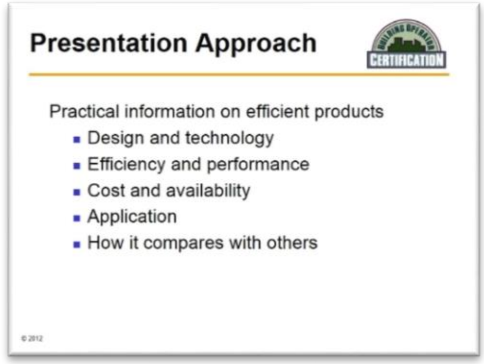


Figure 46: Presentation to SPEER, December 2012 (continued)



Type of Activity	Illuminance Category	Ranges of Illuminances		Reference Work-Plane
		Lux	Footcandles	
Public spaces with dark surroundings	A	20-30-50	2-3-5	General lighting throughout spaces
Simple orientation for short temporary visits	B	50-75-100	5-7.5-10	
Working spaces where visual tasks are only occasionally performed	C	100-150-200	10-15-20	
Performance of visual tasks of high contrast or large size	D	200-300-500	20-30-50	Illuminance on task
Performance of visual tasks of medium contrast or small size	E	500-750-1000	50-75-100	
Performance of visual tasks of low contrast or very small size	F	1000-1500-2000	100-150-200	
Performance of visual tasks of low contrast and very small size over a prolonged period	G	2000-3000-5000	200-300-500	Illuminance on task, obtained by a combination of general and local (supplementary lighting)
Performance of very prolonged and exacting visual task	H	5000-7500-10000	500-750-1000	
Performance of very special visual tasks of extremely low contrast and small size	I	10000-15000-20000	1000-1500-2000	

Figure 46: Presentation to SPEER, December 2012 (continued)



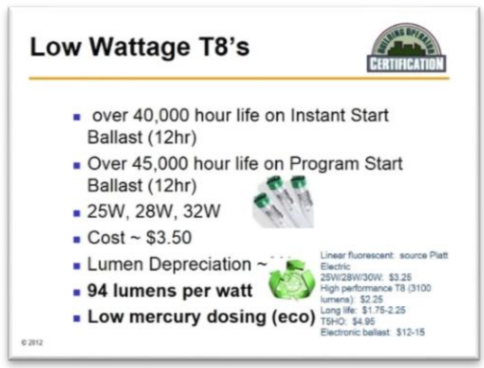
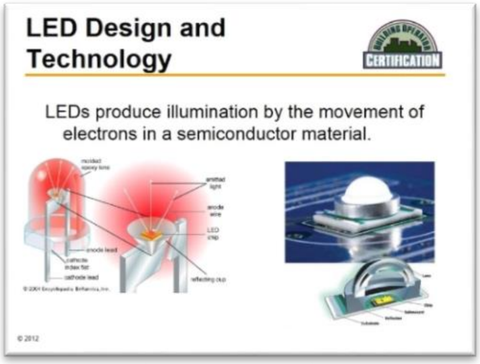
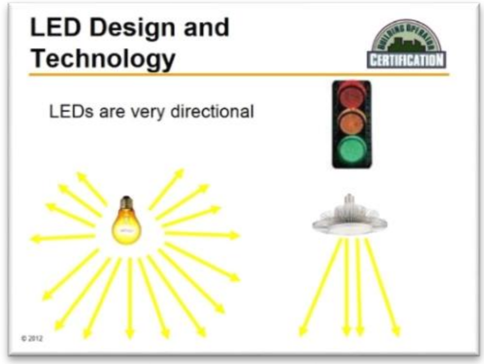


Figure 46: Presentation to SPEER, December 2012 (continued)





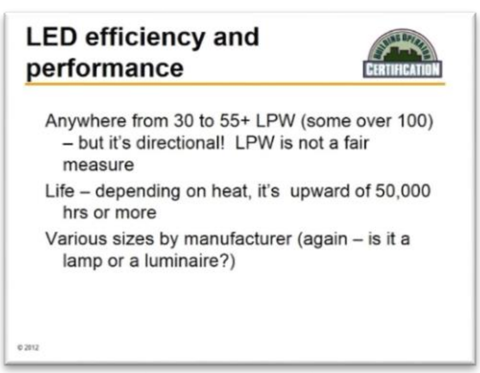
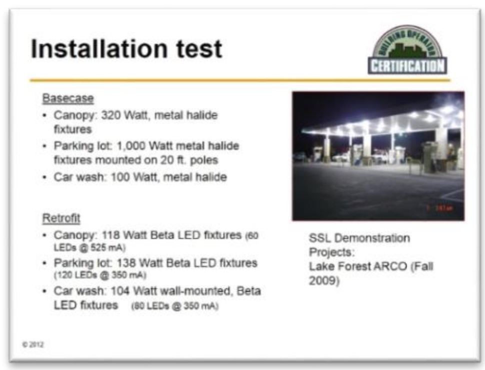


Figure 46: Presentation to SPEER, December 2012 (continued)



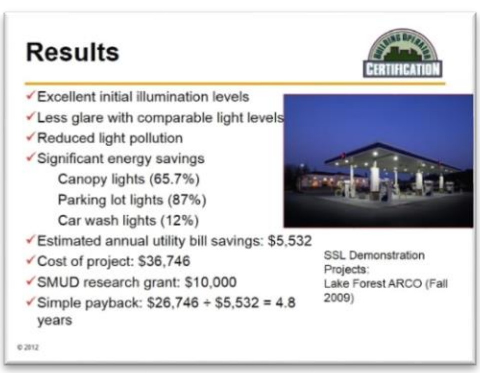
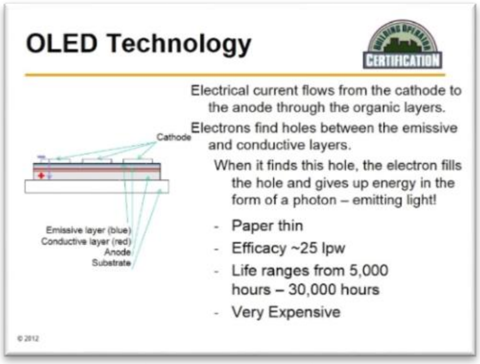
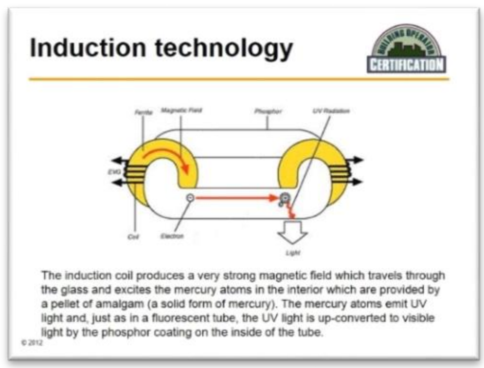


Figure 46: Presentation to SPEER, December 2012 (continued)





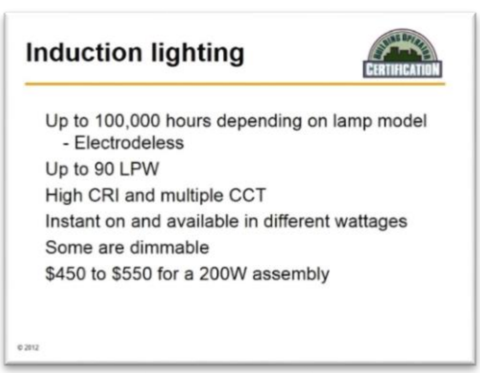
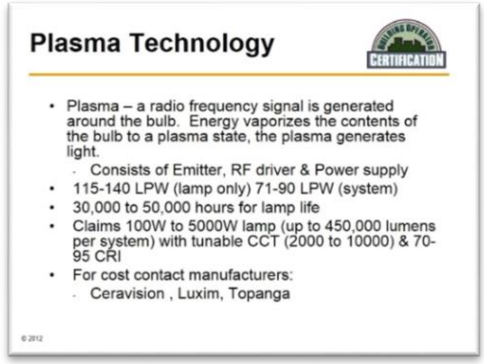


Figure 46: Presentation to SPEER, December 2012 (continued)



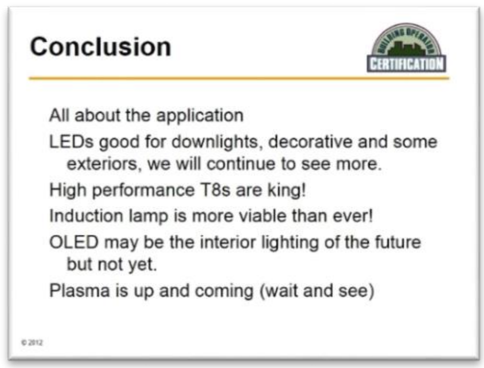
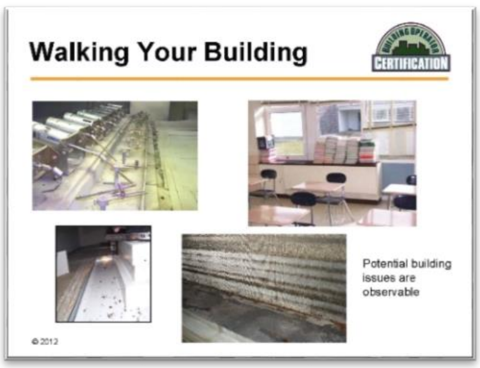
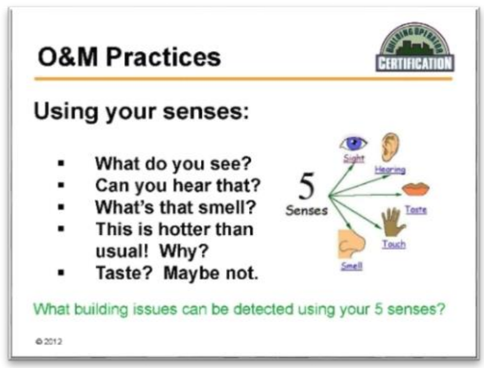
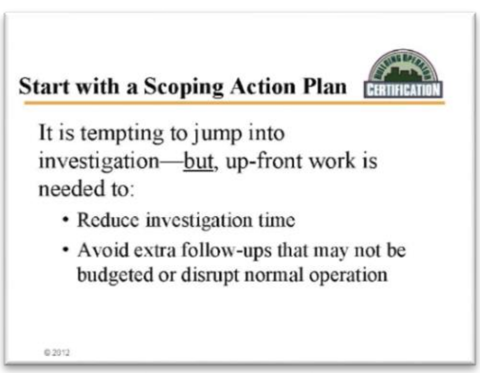


Figure 46: Presentation to SPEER, December 2012 (continued)







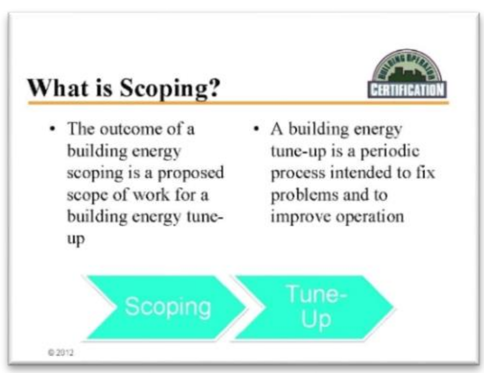
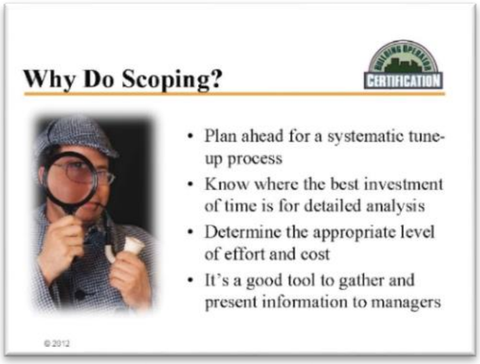
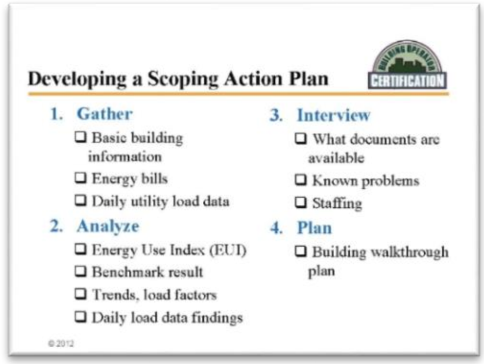
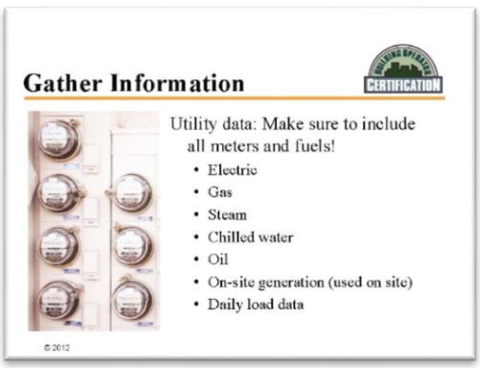
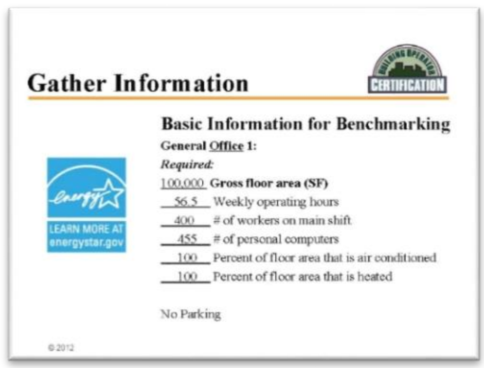


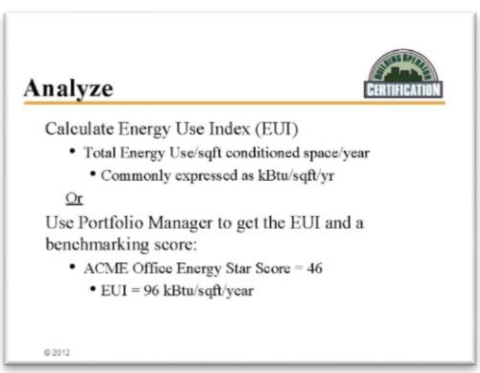
Figure 46: Presentation to SPEER, December 2012 (continued)











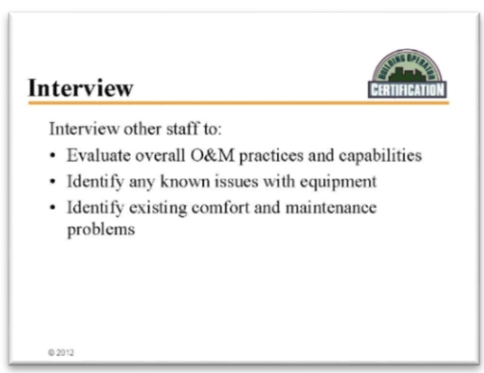
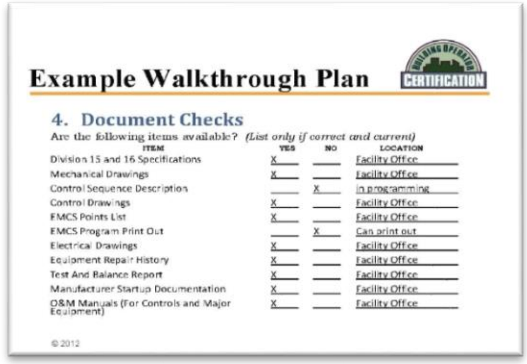
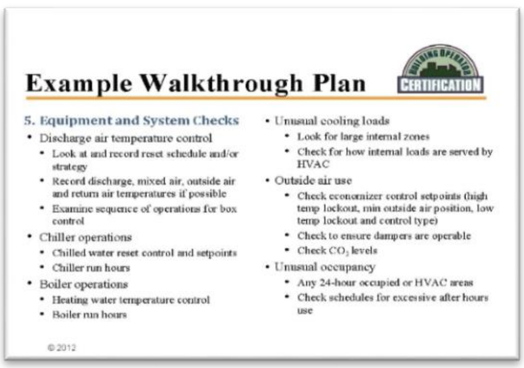
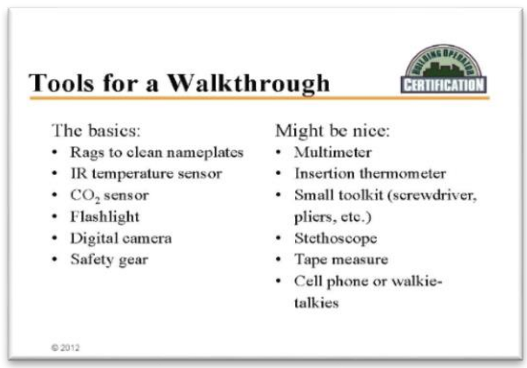


Figure 46: Presentation to SPEER, December 2012 (continued)







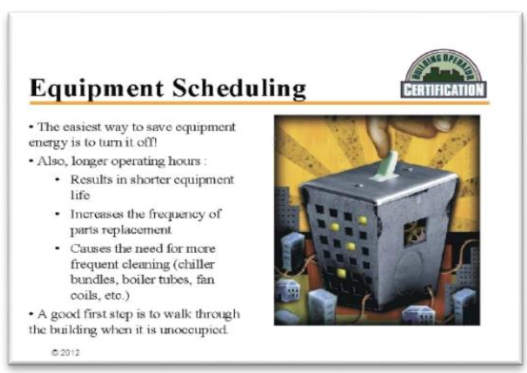
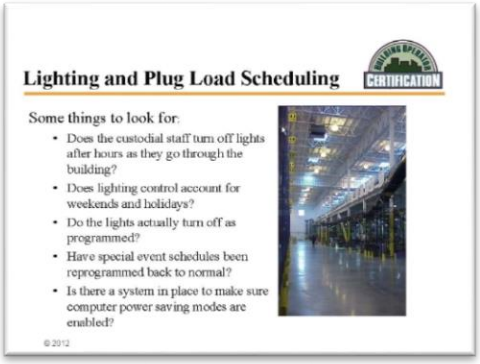
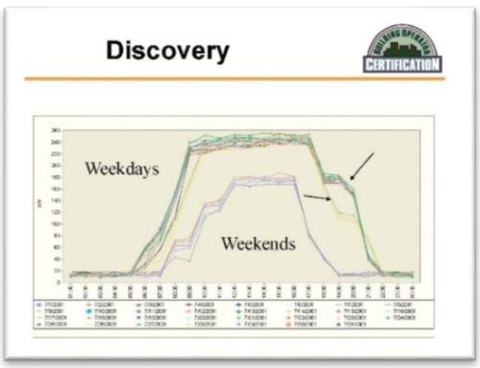
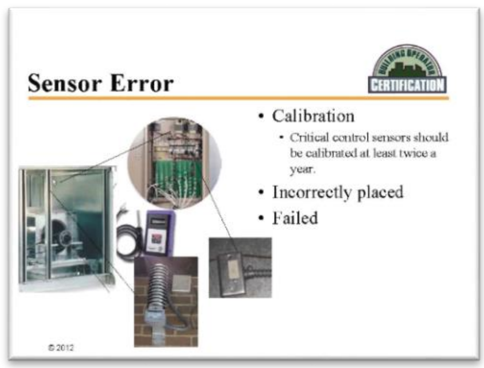
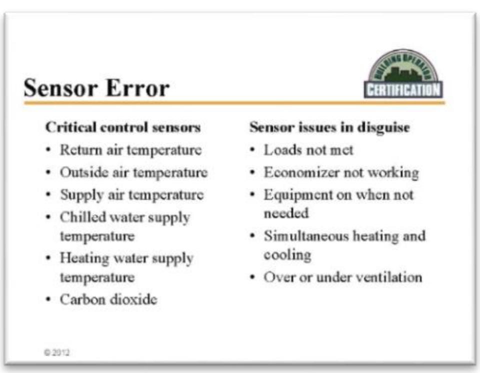


Figure 46: Presentation to SPEER, December 2012 (continued)









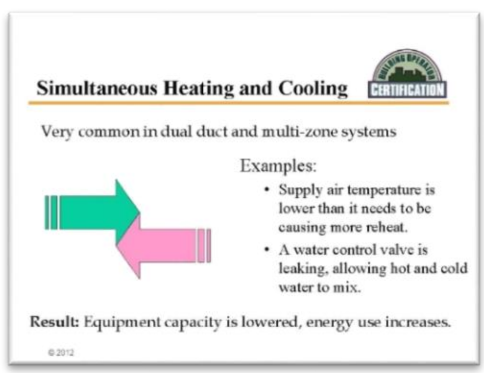
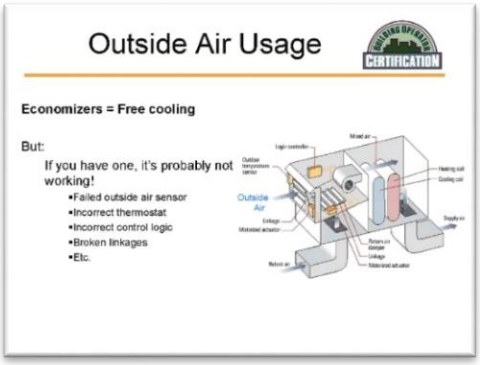
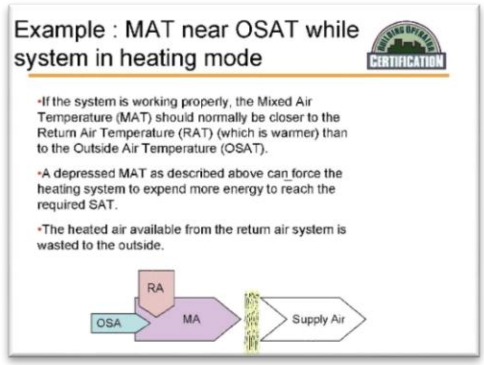
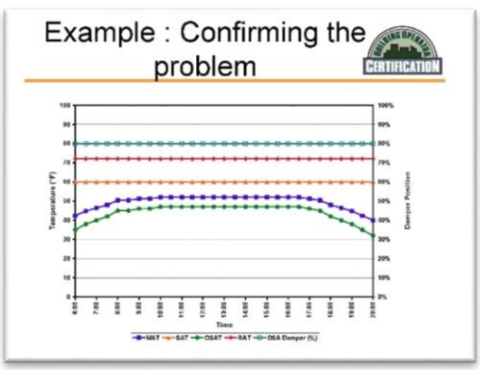
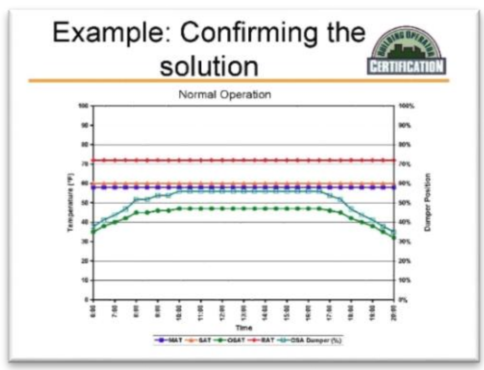


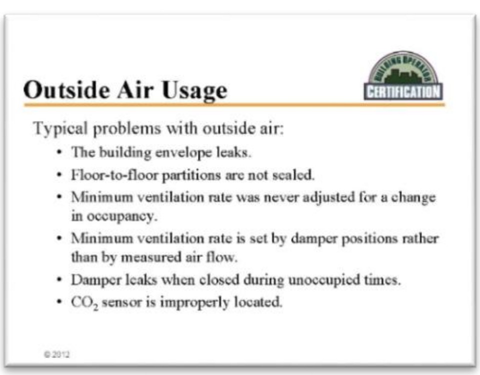
Figure 46: Presentation to SPEER, December 2012 (continued)











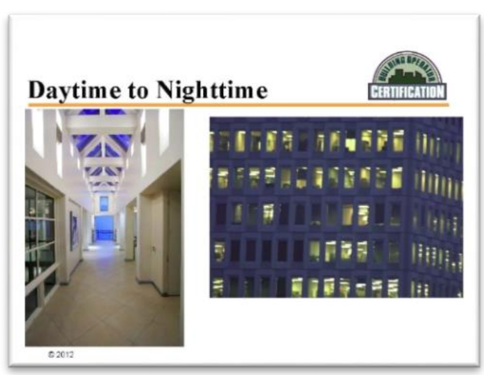
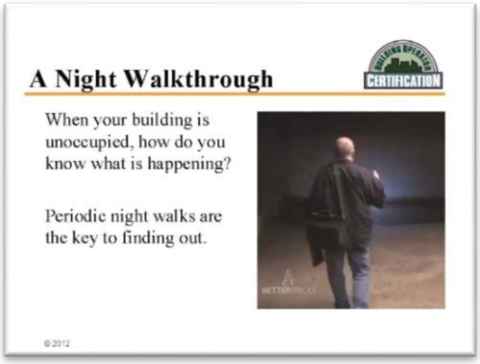
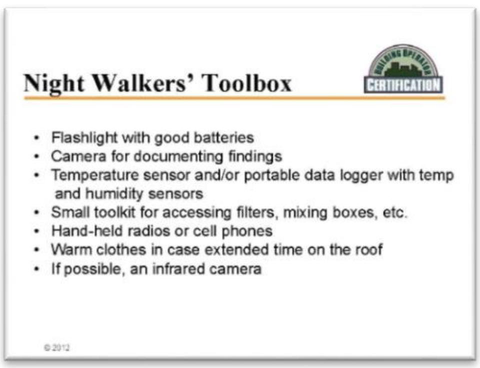


Figure 46: Presentation to SPEER, December 2012 (continued)





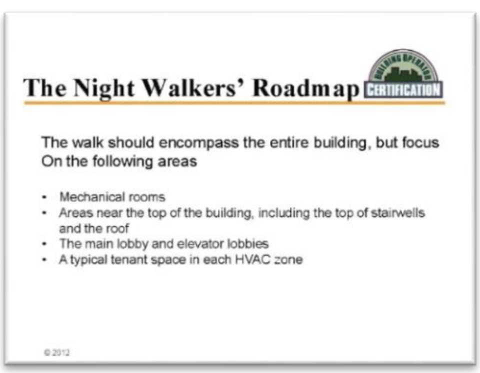
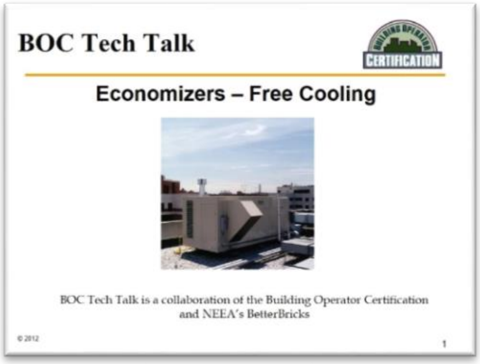
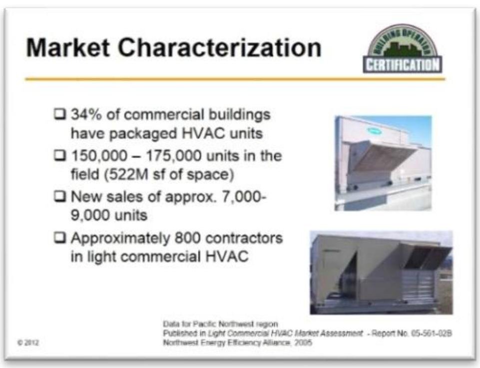
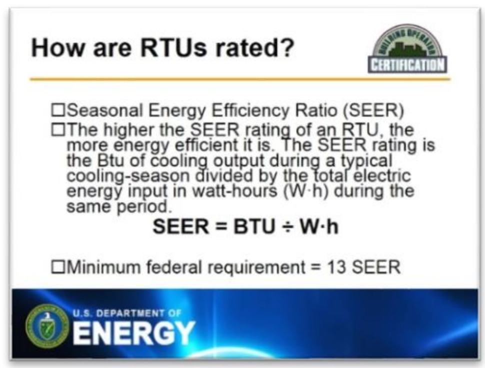


Figure 46: Presentation to SPEER, December 2012 (continued)







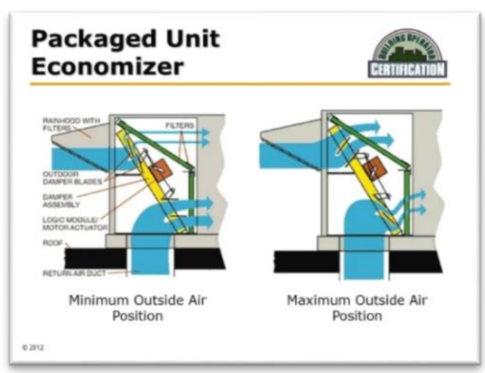
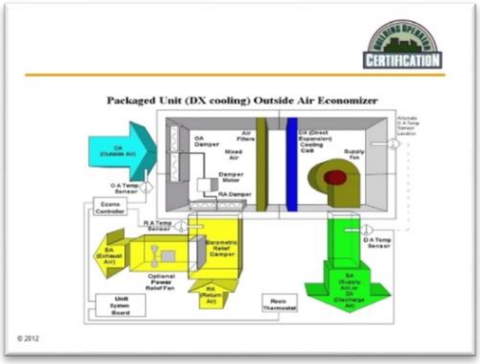
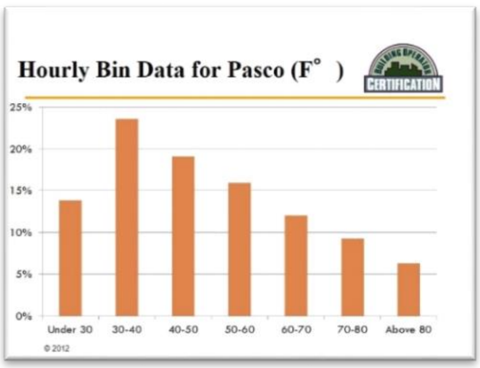
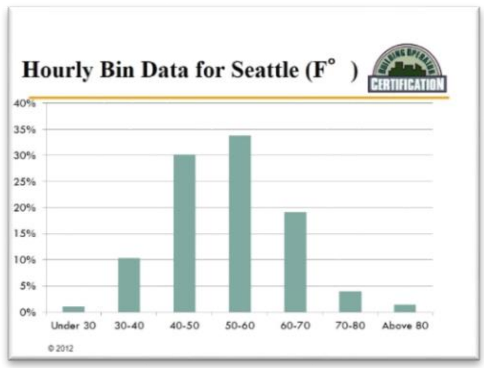


Figure 46: Presentation to SPEER, December 2012 (continued)







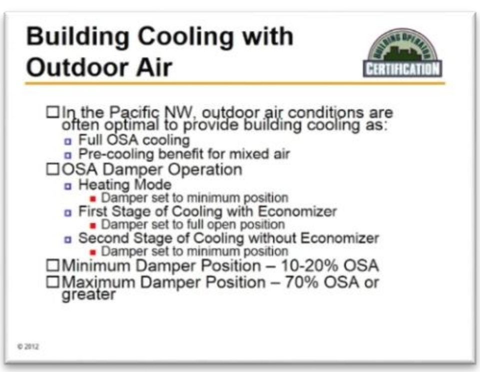
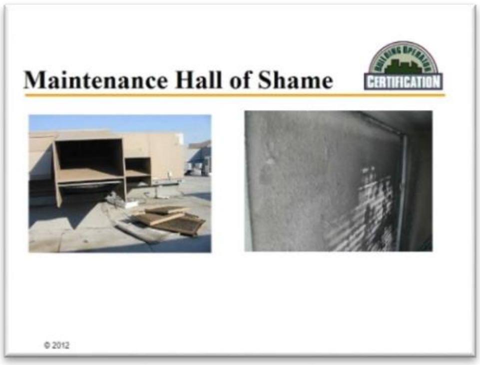
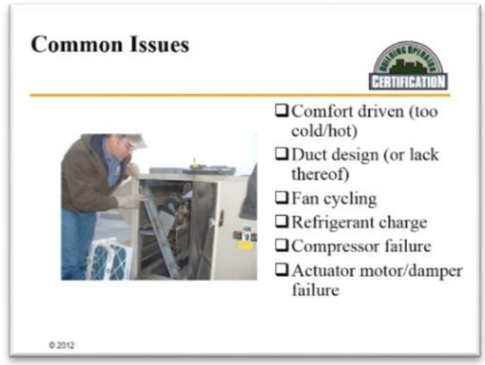
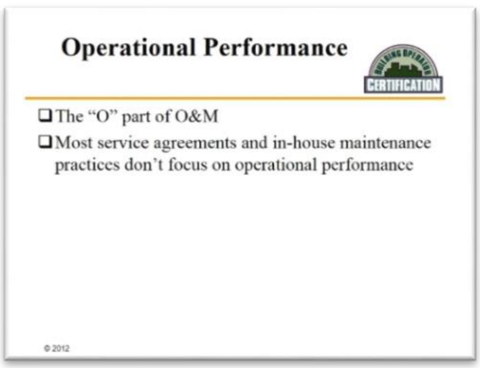


Figure 46: Presentation to SPEER, December 2012 (continued)







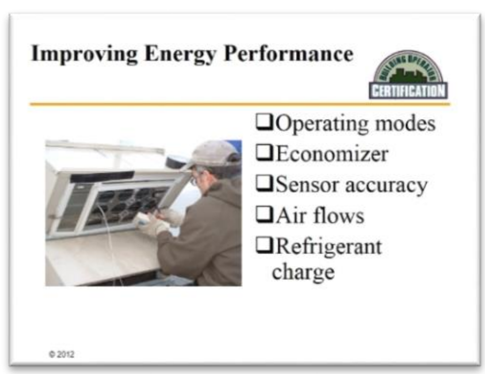


Figure 46: Presentation to SPEER, December 2012 (continued)

RTU Economizer Evaluation

- ☐ Thermostat review
  - Heating and cooling setpoints
  - Occupied/Unoccupied schedules
  - Is thermostat wired for two stages of cooling?
  - Can morning warm-up be enabled?
- ☐ Economizer review
  - OSA, RA and MA temperature sensors type, location and condition
  - Is the OSA sensor a Honeywell C7650?
  - Control logic setting and condition of controller
  - Damper assembly condition – Damper, linkage, seal and motor

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RTU Economizer Evaluation

Airflow testing
- Minimum and maximum OSA settings and flow

Evaporator and condenser coils review
- Surface condition of coil
- Coil delta T (indicator of refrigerant charge)

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Economizer Function

- •Controller issues
- •Sensors
- •Differential control – Single point changeover

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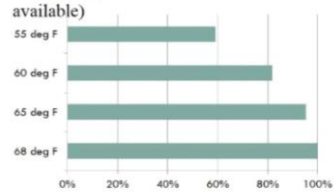
Seattle Area

- Impact of Changeover Setpoint on Economizer Cooling Opportunity (Based on % of hours available)



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Thermostat Issues

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Thermostat Issues

- ❑ Room temperature setpoint
  - Occupied mode set to minimal deadband
  - Unoccupied mode setpoints not expanded to broader temperature range than in occupied mode.
- ❑ Thermostats only have a single stage call for cooling versus two stage
  - Stage 1 – Adjust OSA damper to full open position
  - Stage 2 – Activate Compressor
- ❑ Does not have sufficient wiring or adjustability to enable morning warm-up

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Figure 46: Presentation to SPEER, December 2012 (continued)

Presentation to ICEBO, October 2012

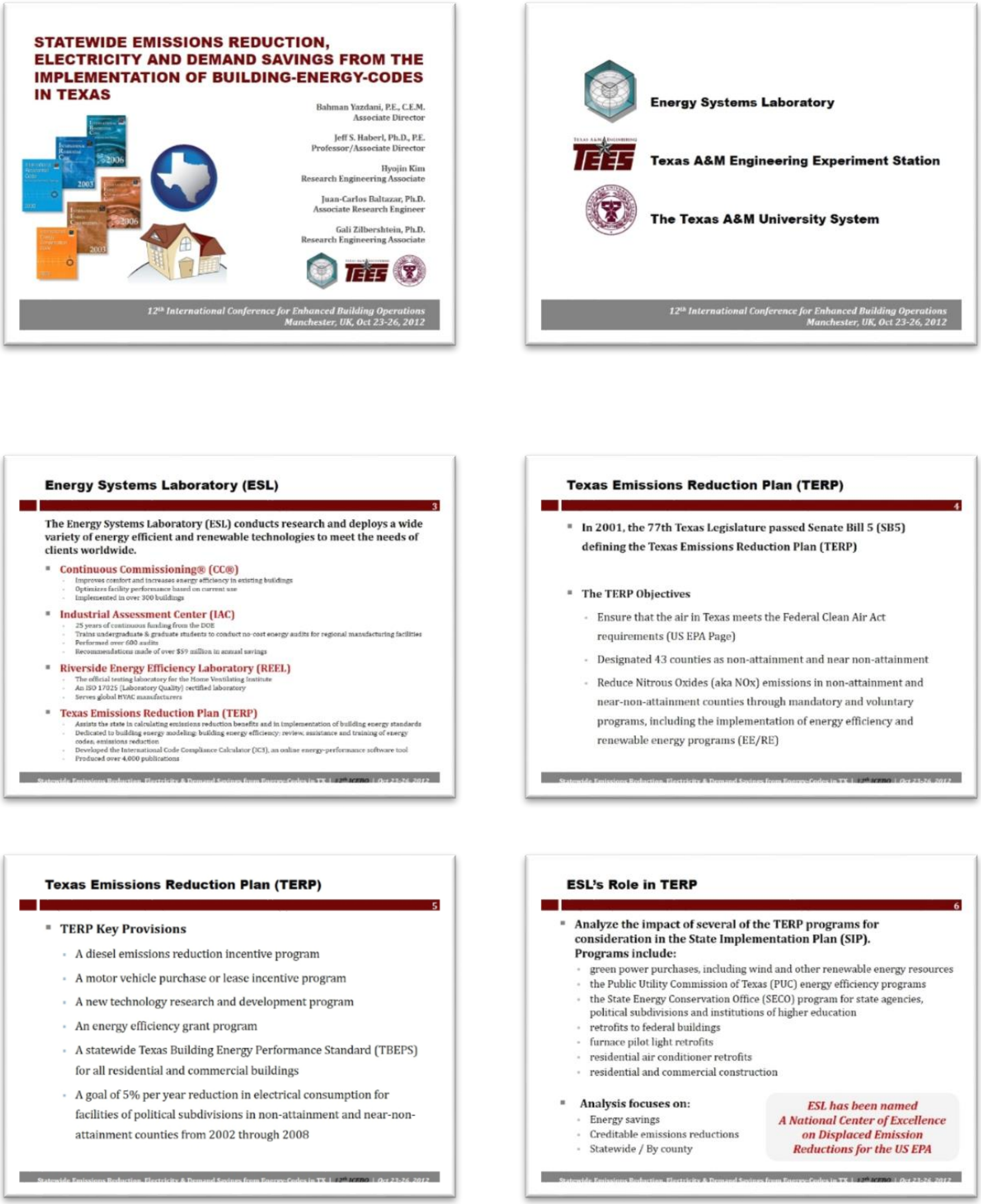
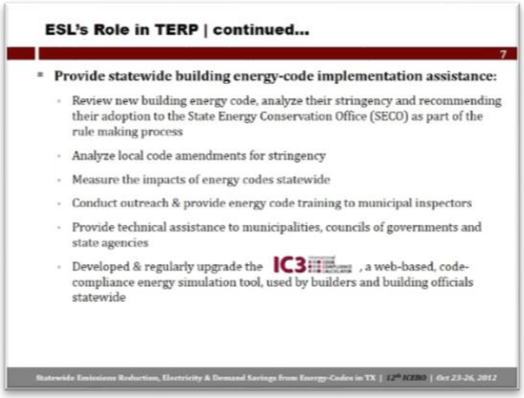
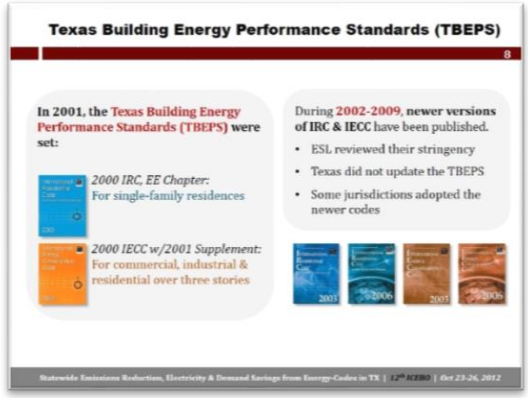
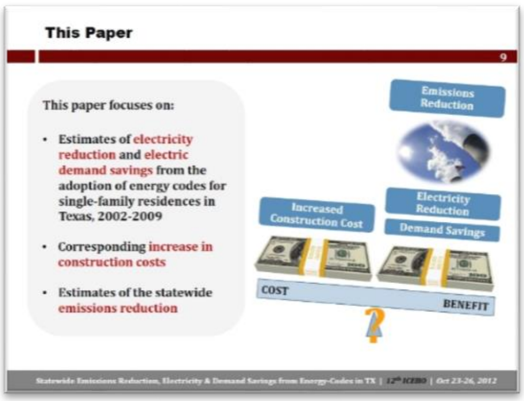
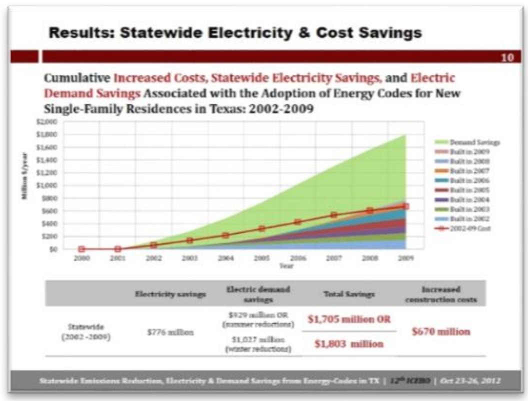


Figure 47: Presentation to ICEBO, October 2012

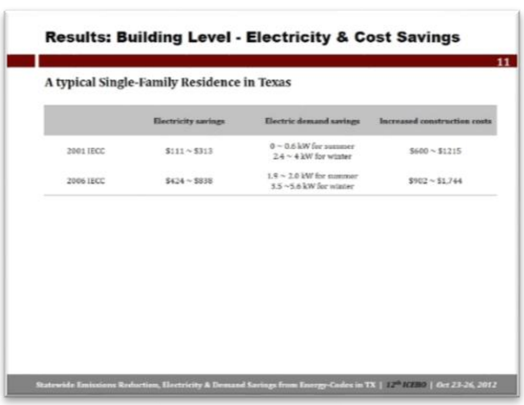




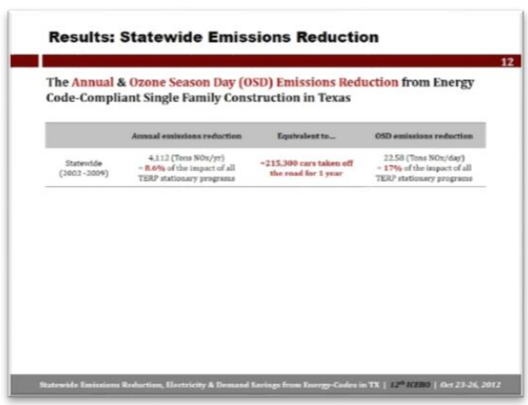




	Electricity savings	Electric demand savings	Total Savings	Increased construction costs
Statewide (2002-2009)	$776 million	$929 million OR (summer reductions) $1,027 million (winter reductions)	$1,705 million OR $1,803 million	$670 million



	Electricity savings	Electric demand savings	Increased construction costs
2001 IECC	$111 ~ $313	0 ~ 0.6 kW for summer 2.4 ~ 4 kW for winter	$600 ~ $1215
2006 IECC	$424 ~ $838	1.9 ~ 2.0 kW for summer 3.5 ~5.6 kW for winter	$902 ~ $1,744

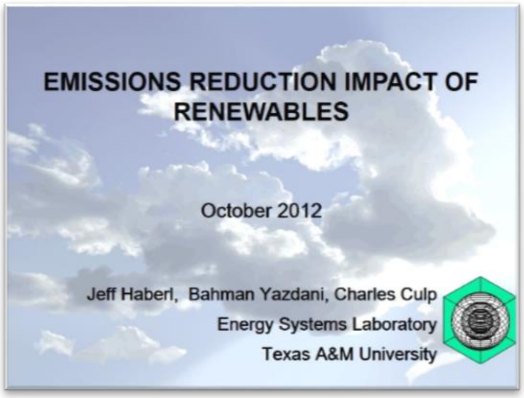


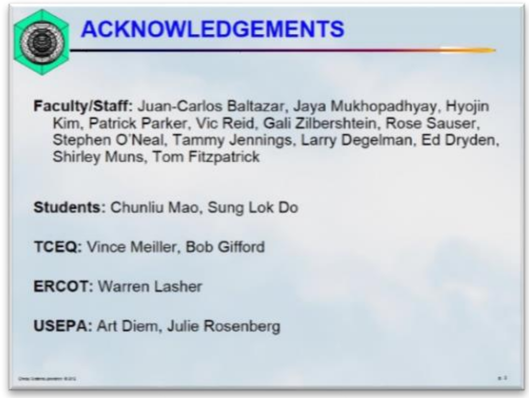
	Annual emissions reduction	Equivalent to...	OSD emissions reduction
Statewide (2002-2009)	4,112 (Tons NOx/yr) ~ 8.6% of the impact of all TERP stationary programs	~215,300 cars taken off the road for 1 year	22.58 (Tons NOx/day) ~ 17% of the impact of all TERP stationary programs

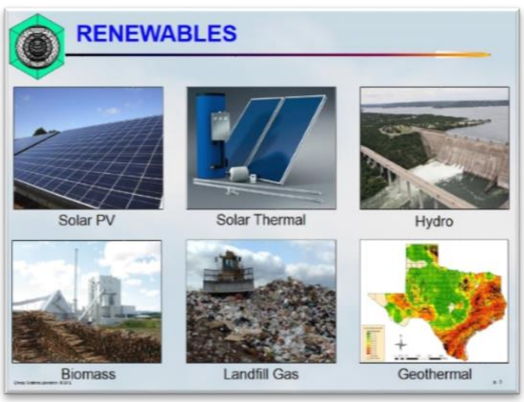
Figure 47: Presentation to ICEBO, October 2012 (continued)

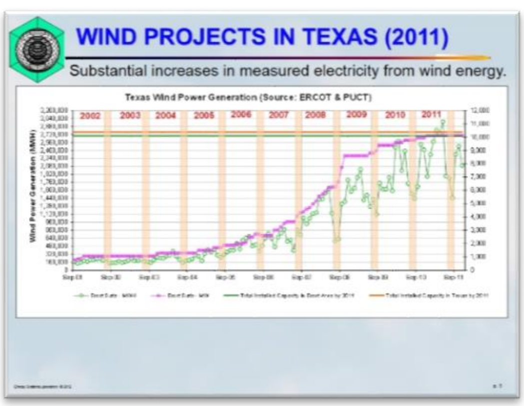
Figure 47: Presentation to ICEBO, October 2012 (continued)

Presentation to Clean Air Through Energy Efficiency Conference, October 2012, Galveston, Texas









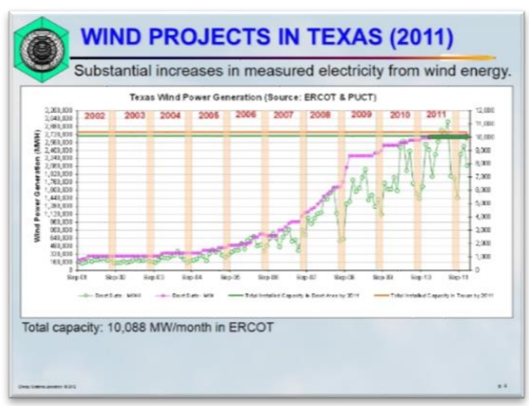
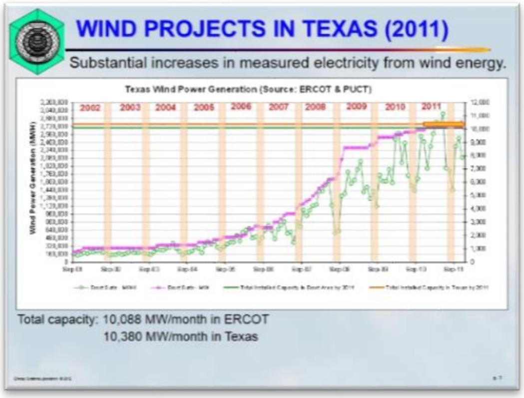
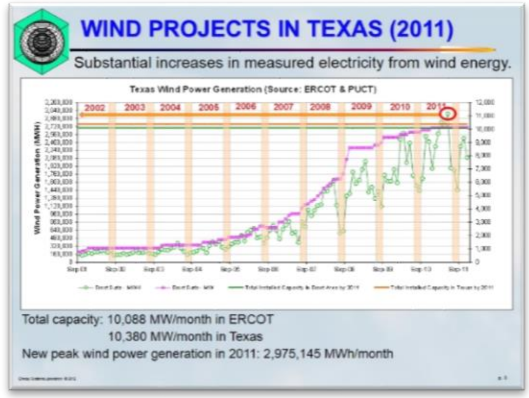
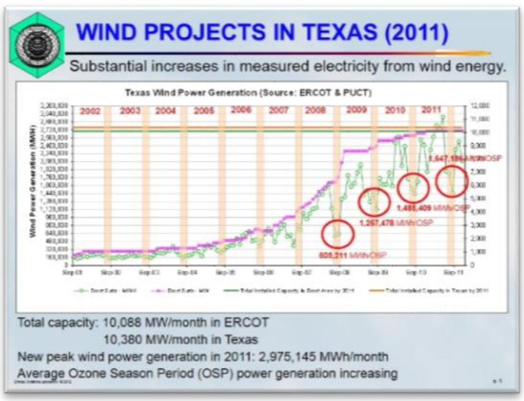
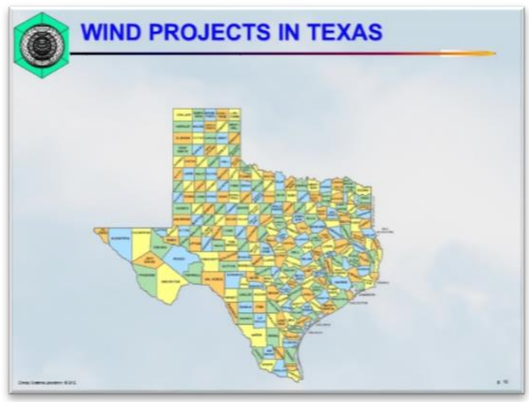


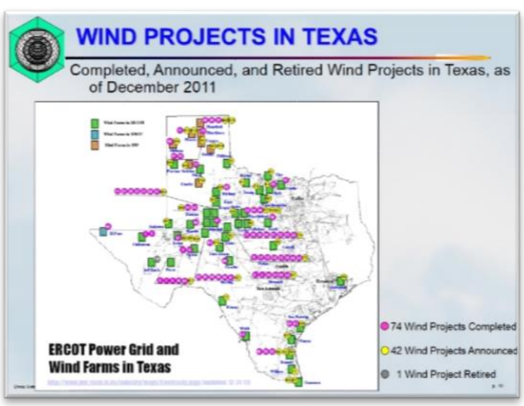
Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference











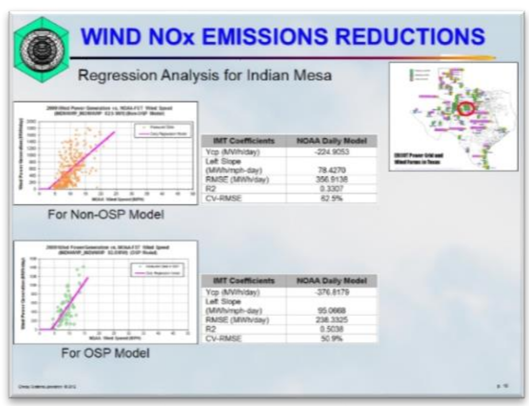
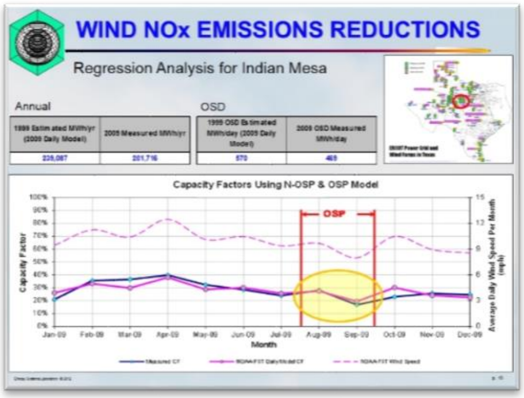
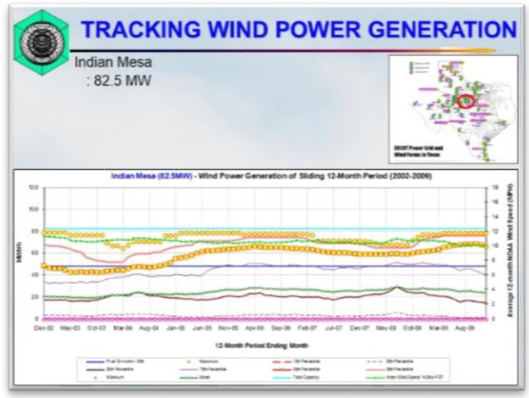
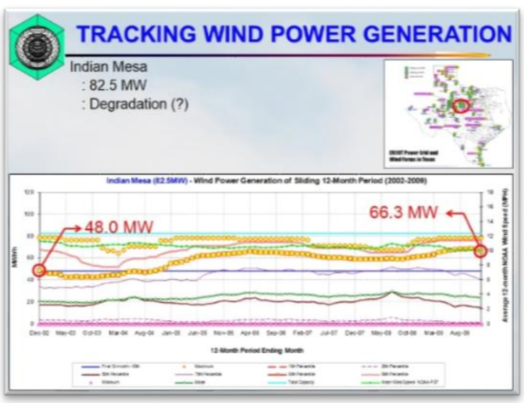
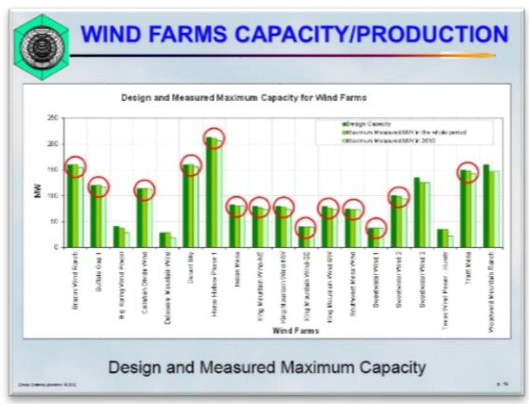


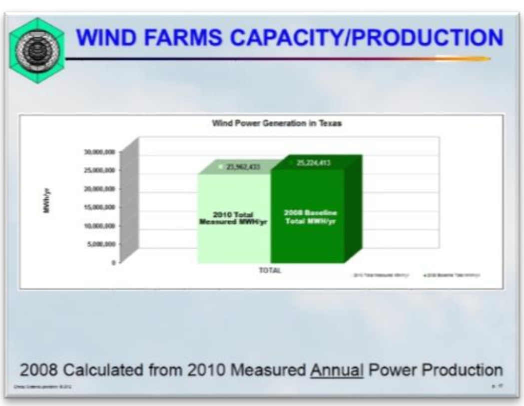
Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (continued)











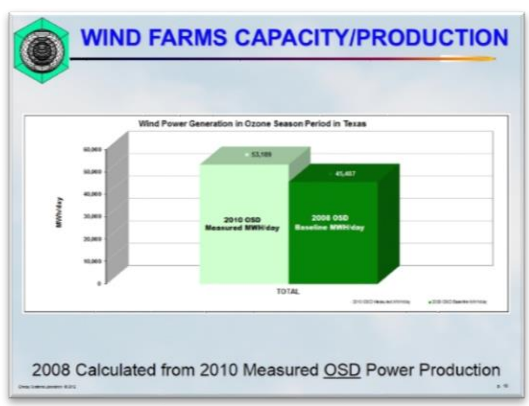
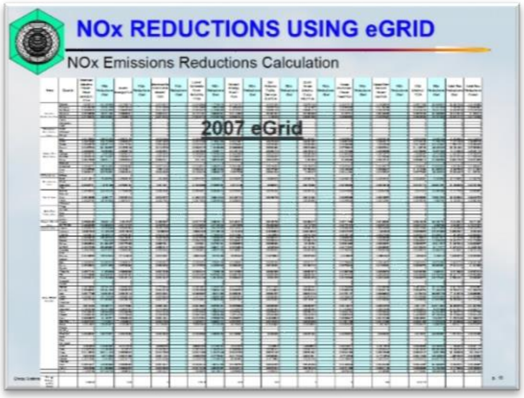
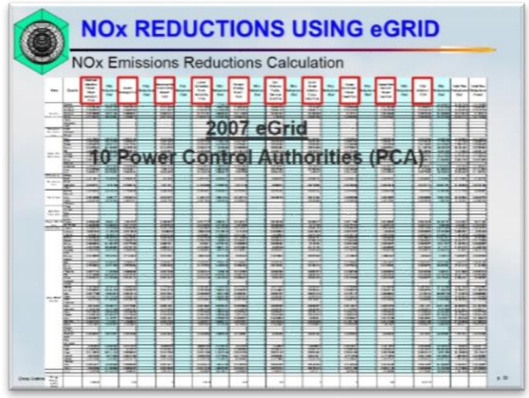
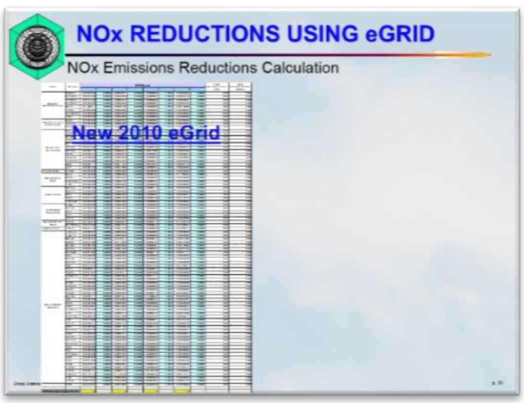
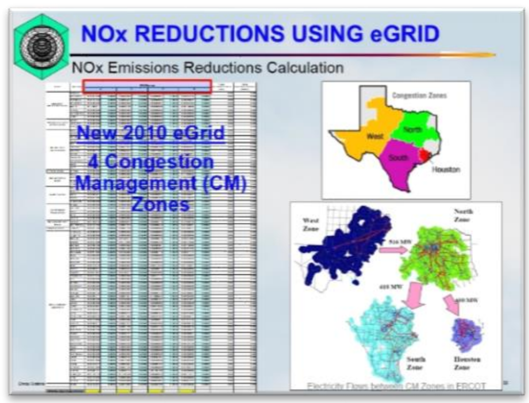


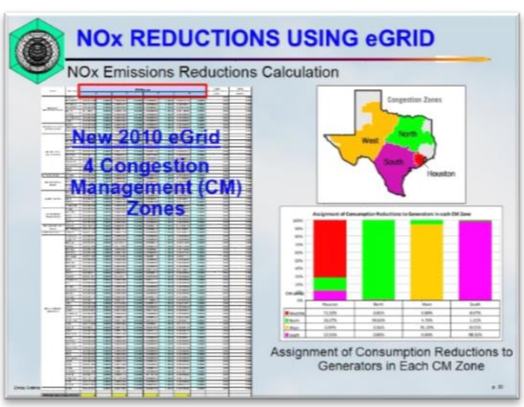
Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)











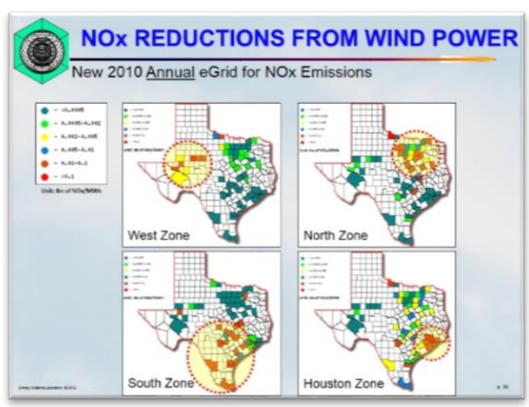
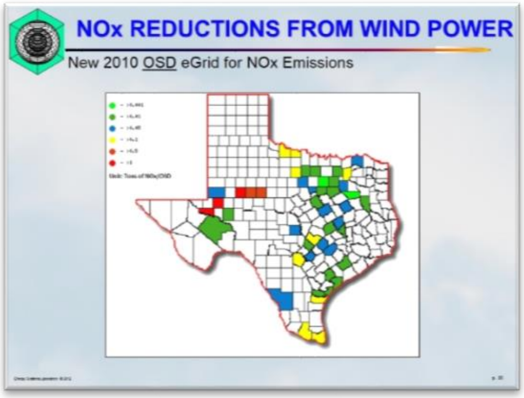
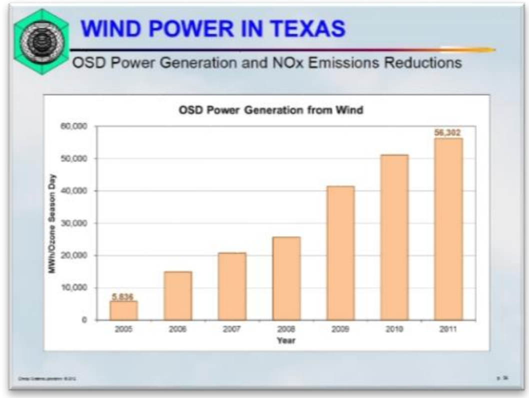
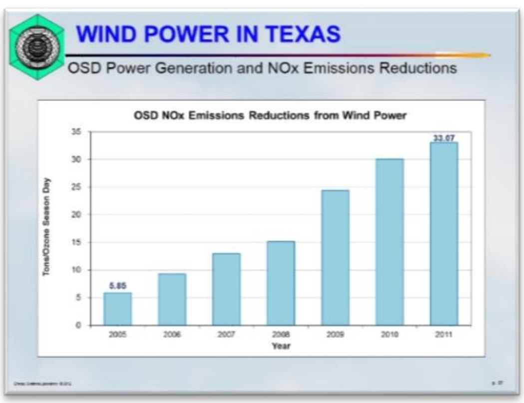
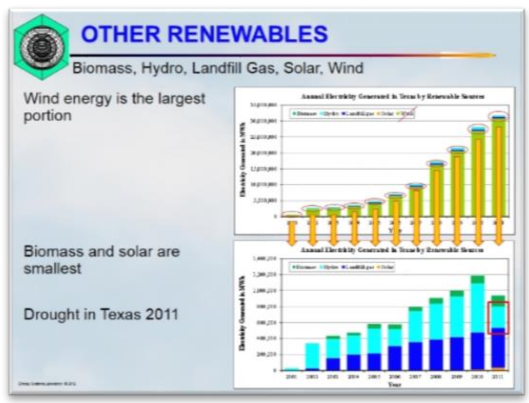


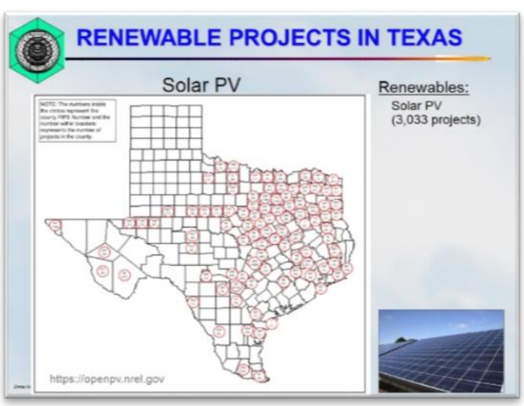
Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)











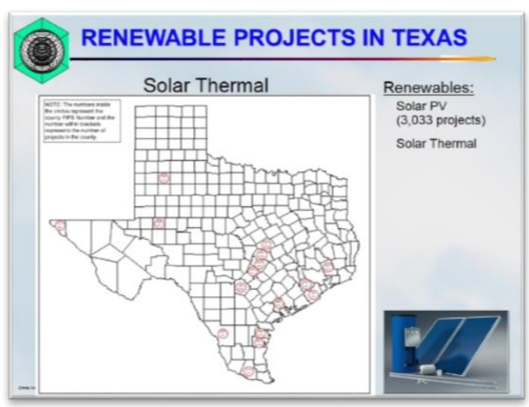
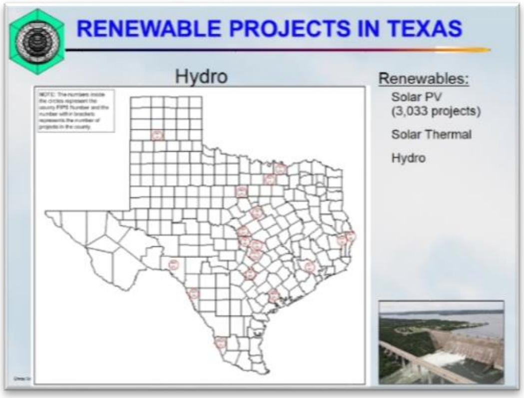
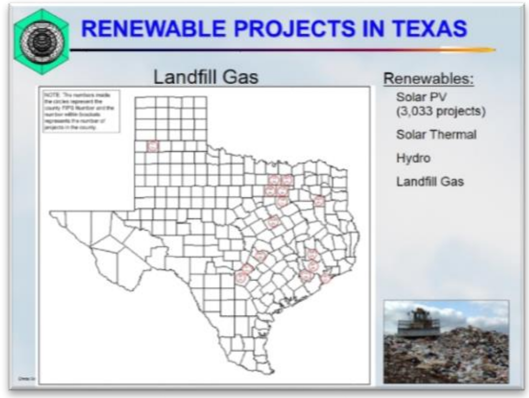
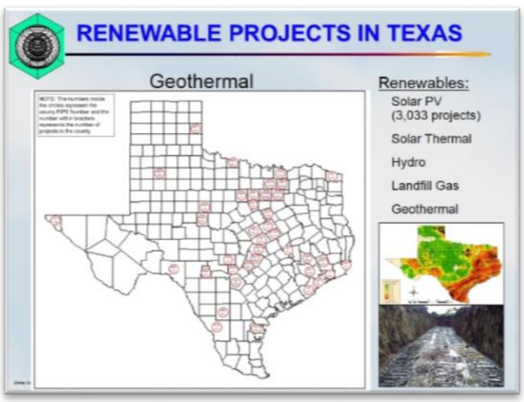
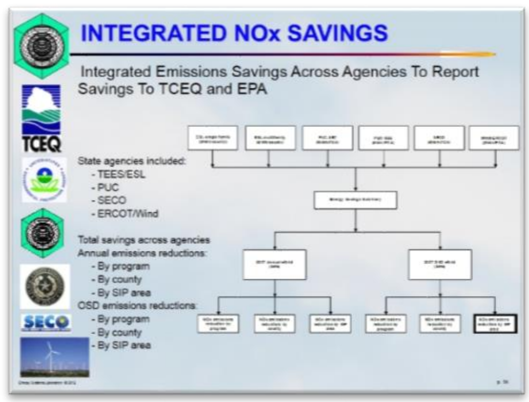


Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)









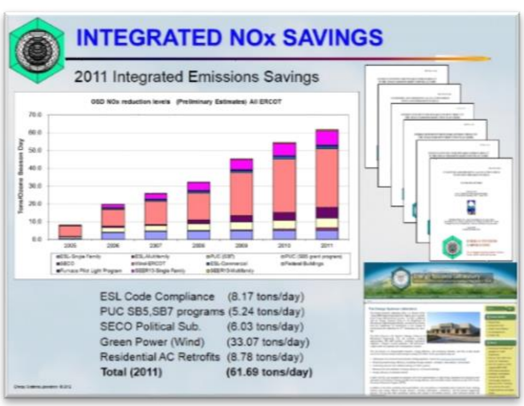
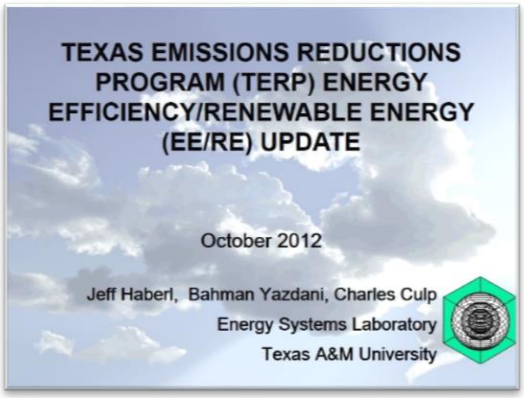
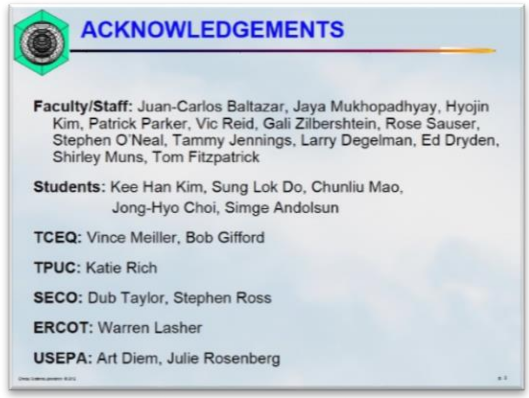
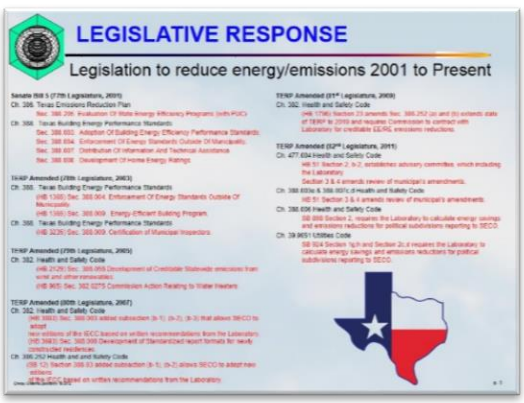
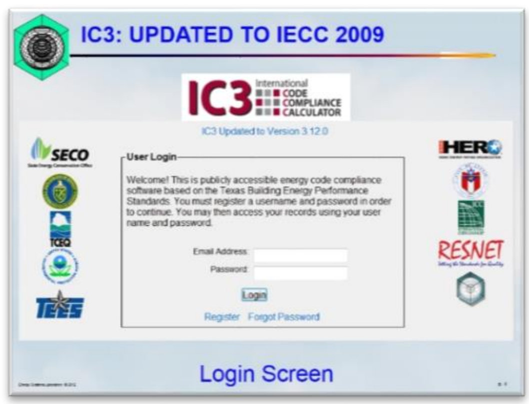


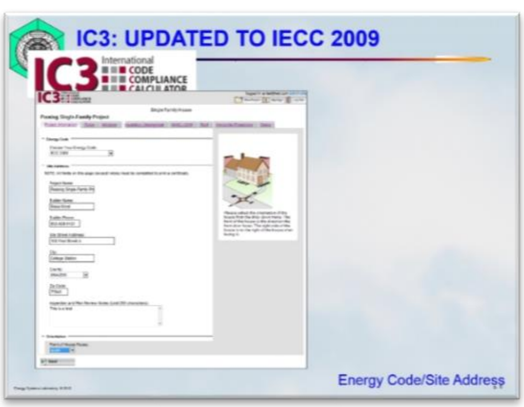
Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)











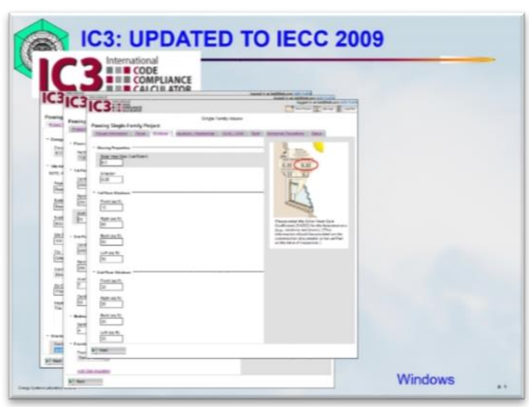
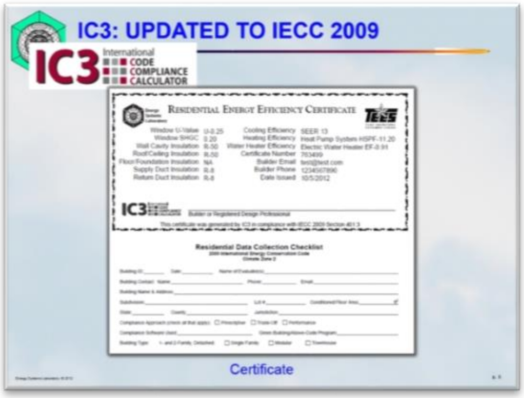
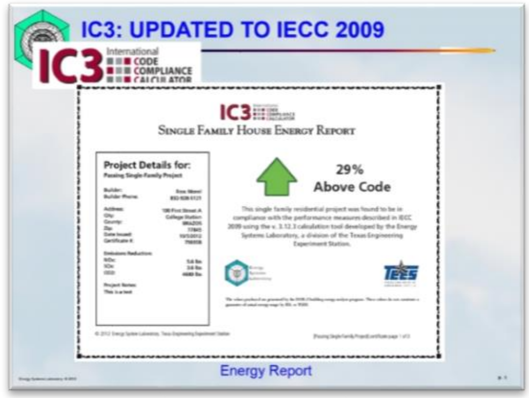
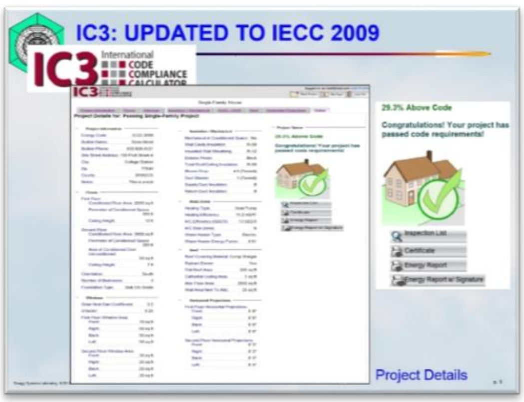
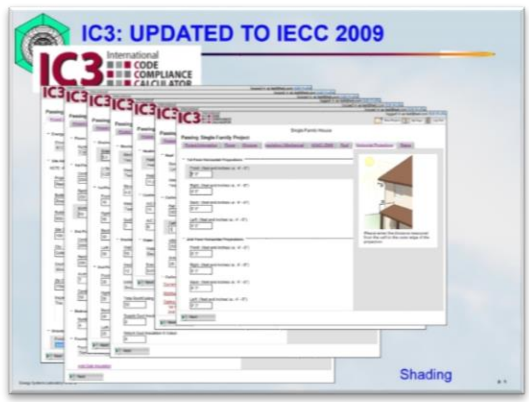


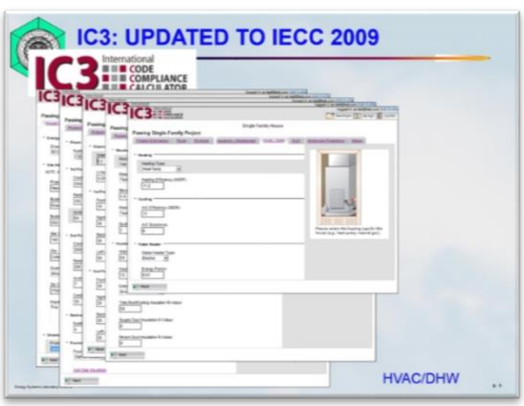
Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference











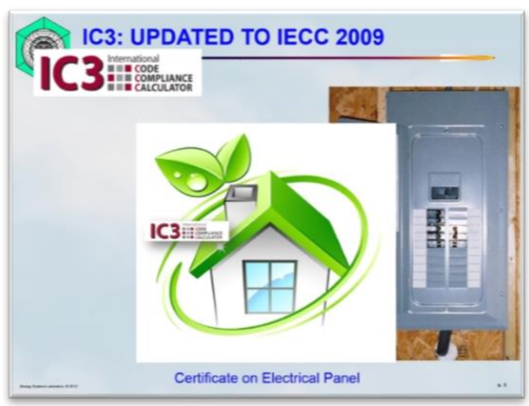
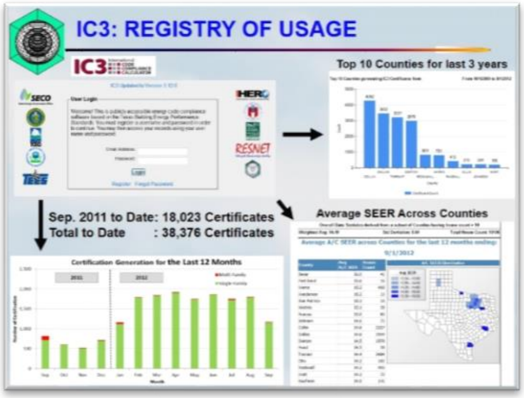
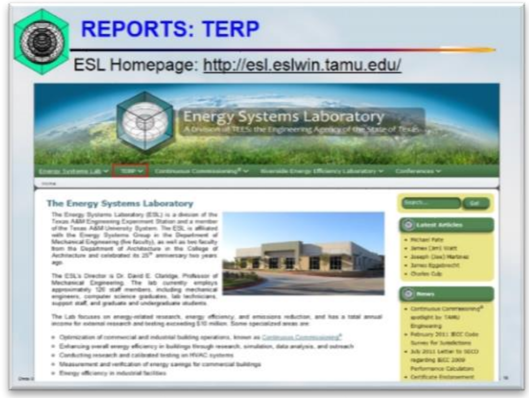
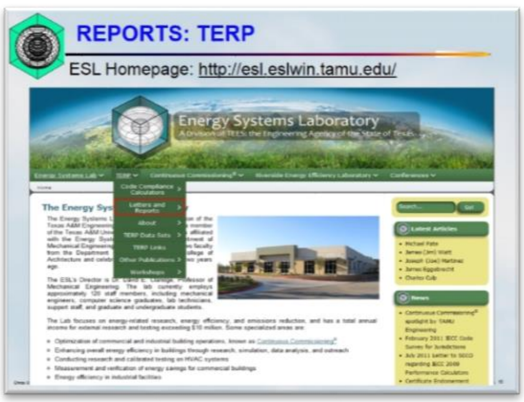
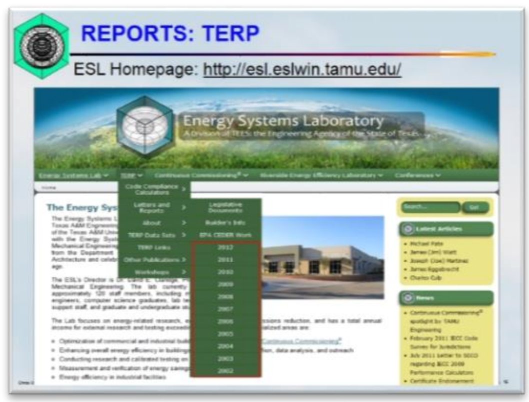


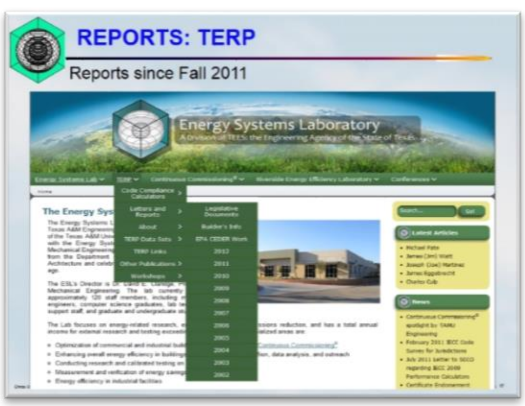
Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)











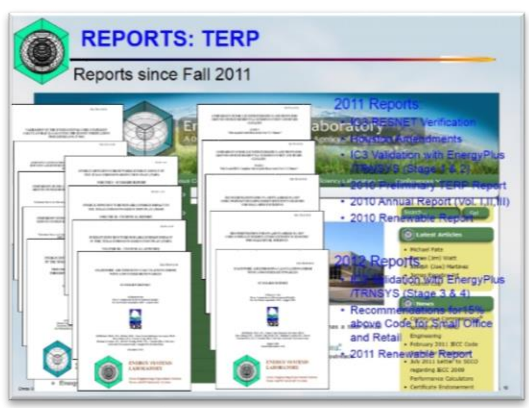
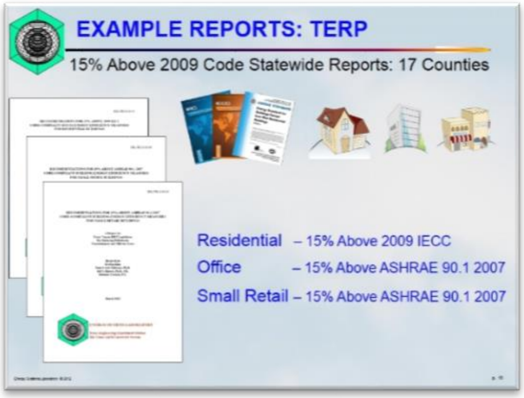
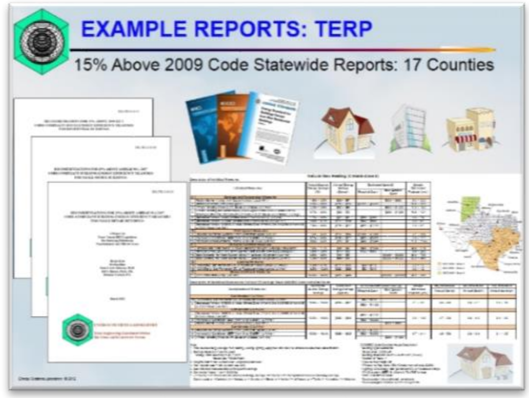
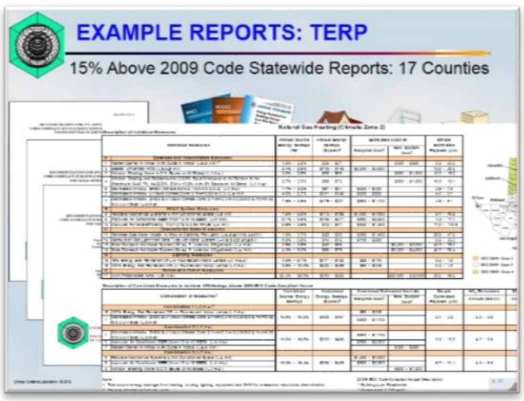
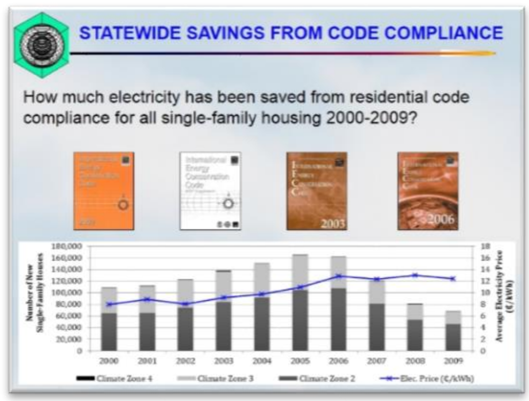


Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)









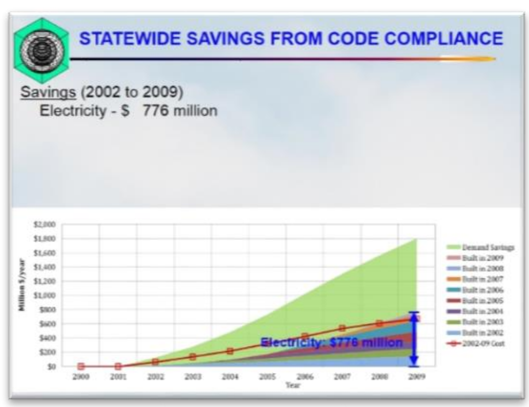
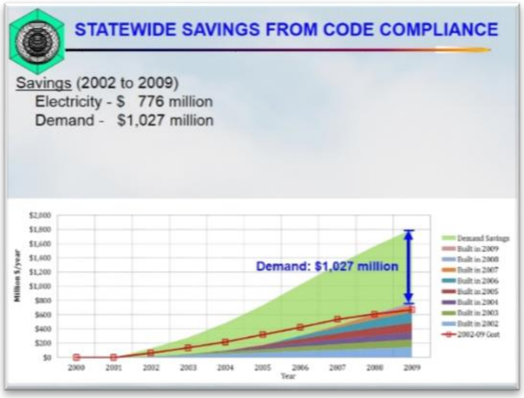
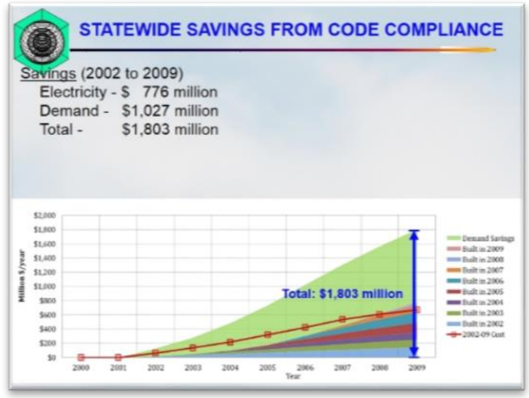
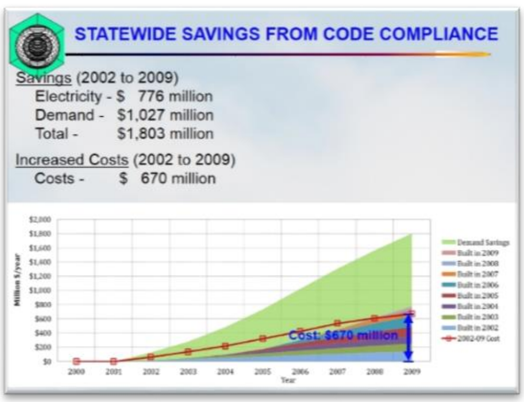
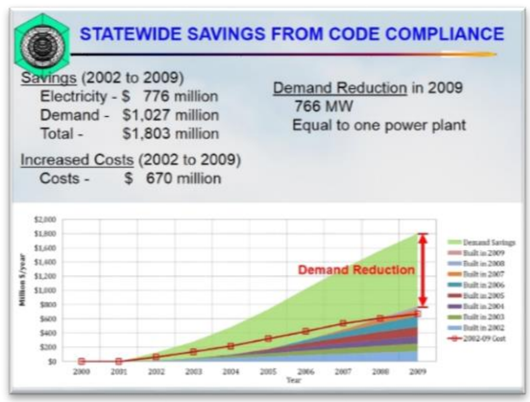


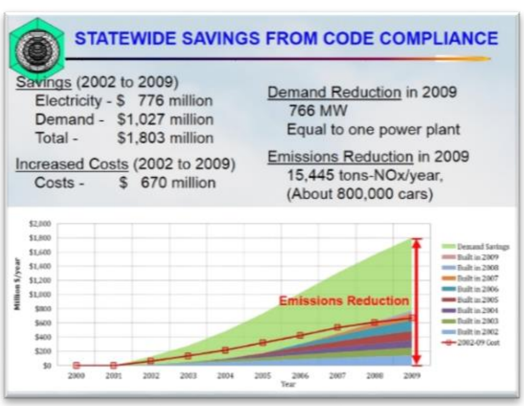
Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)











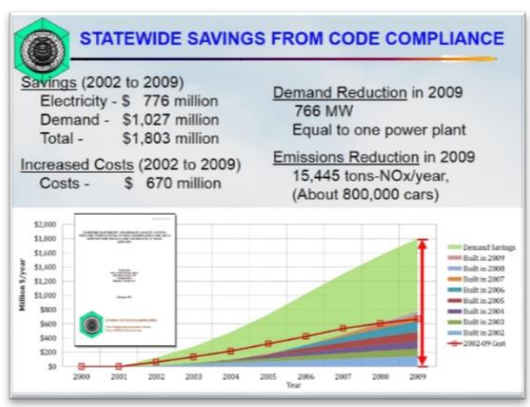
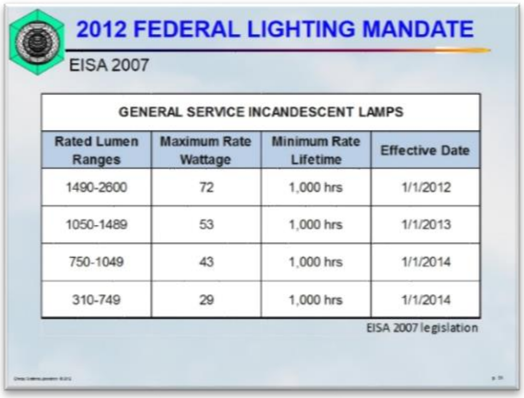


Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)



Rated Lumen Ranges	Maximum Rate Wattage	Minimum Rate Lifetime	Effective Date
1490-2600	72	1,000 hrs	1/1/2012
1050-1489	53	1,000 hrs	1/1/2013
750-1049	43	1,000 hrs	1/1/2014
310-749	29	1,000 hrs	1/1/2014

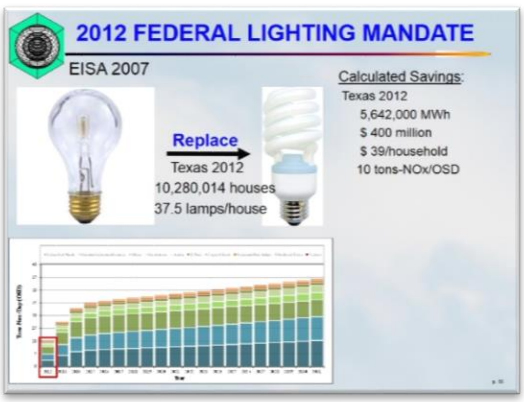
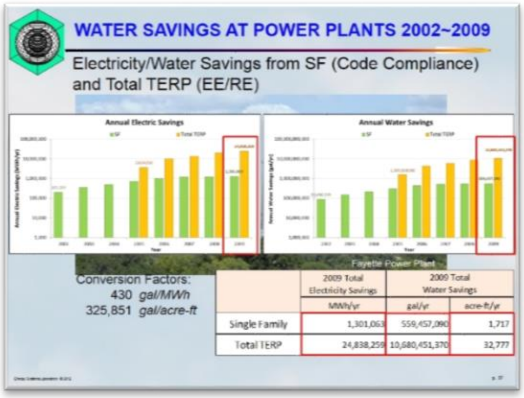
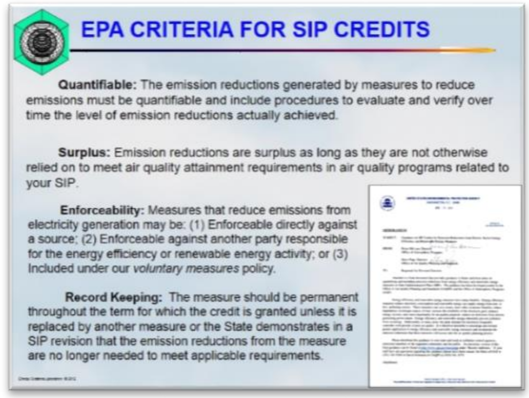
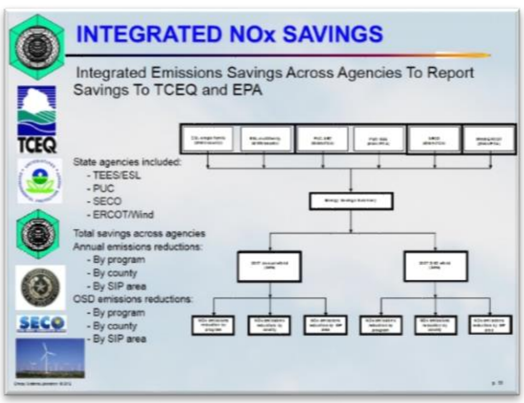


Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)







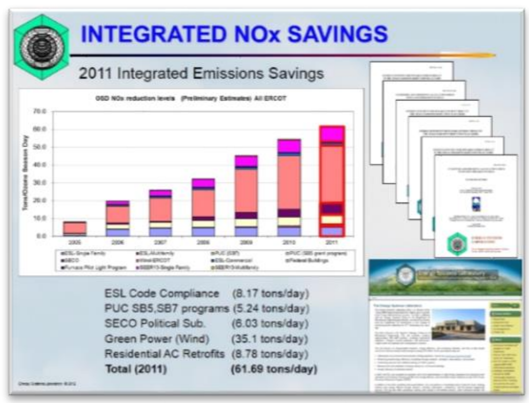
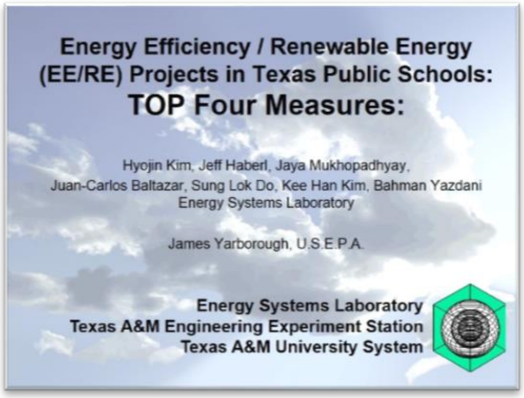
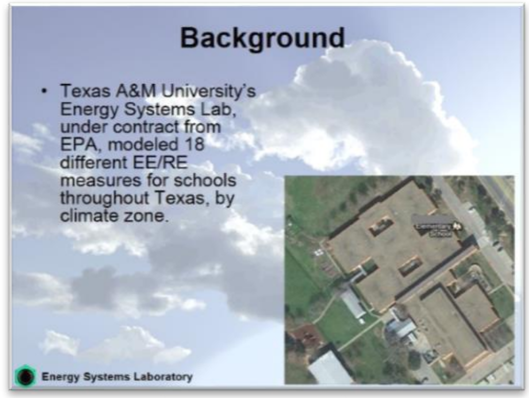
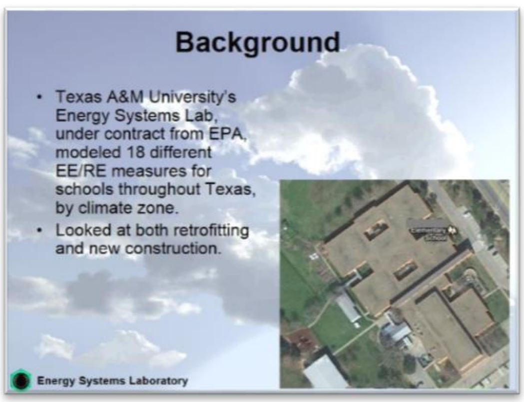
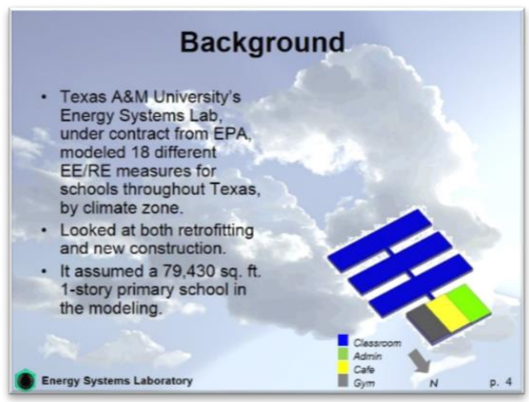


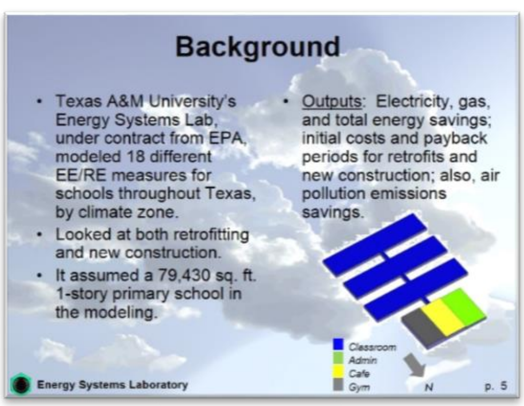
Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)











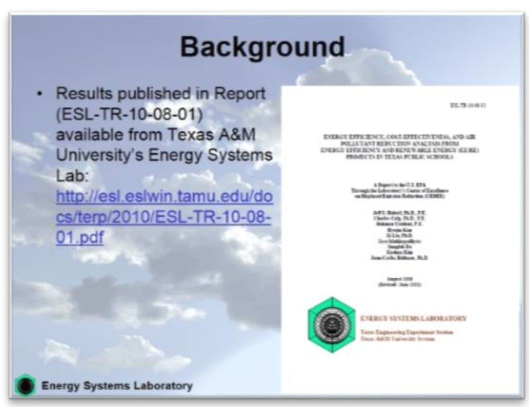
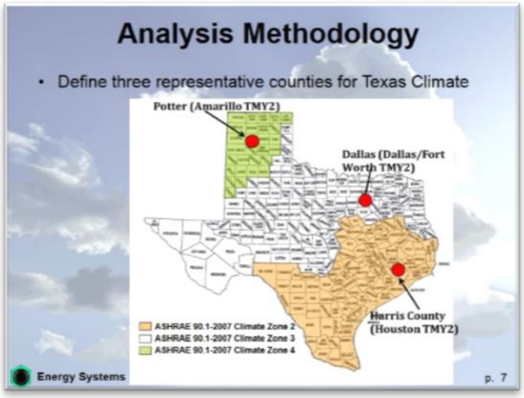
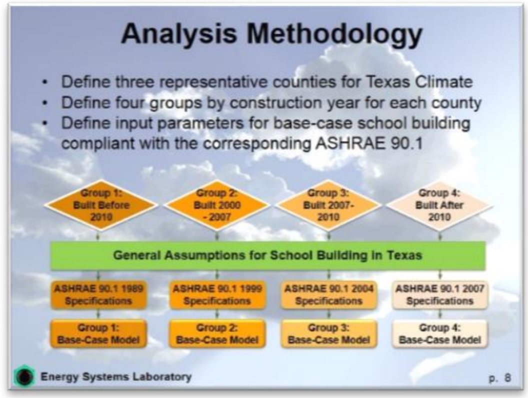
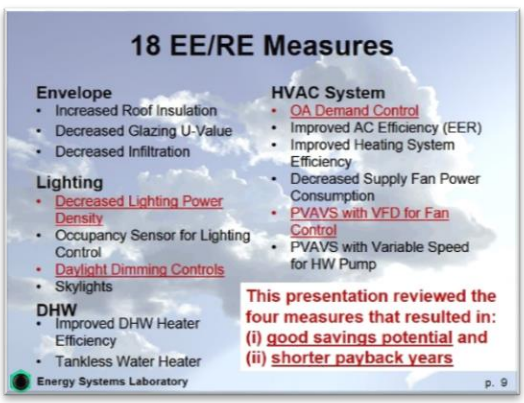
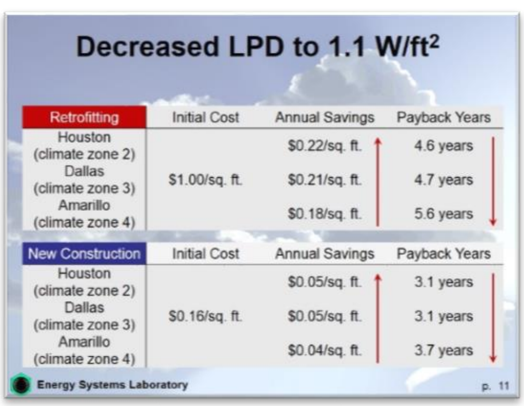


Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)









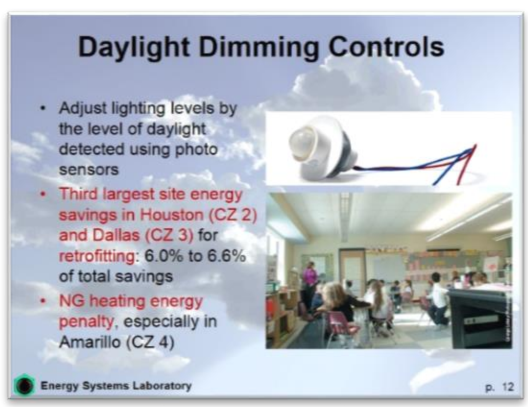
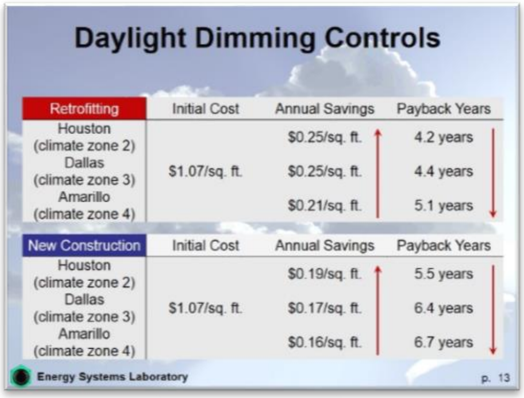
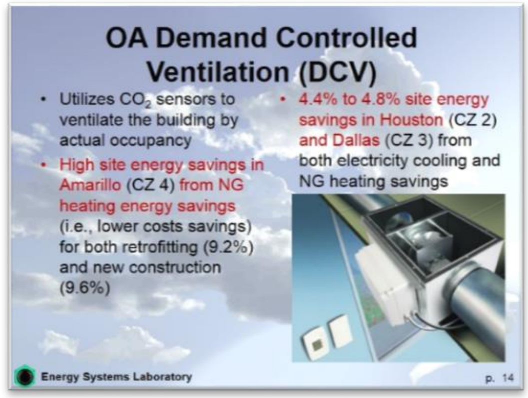
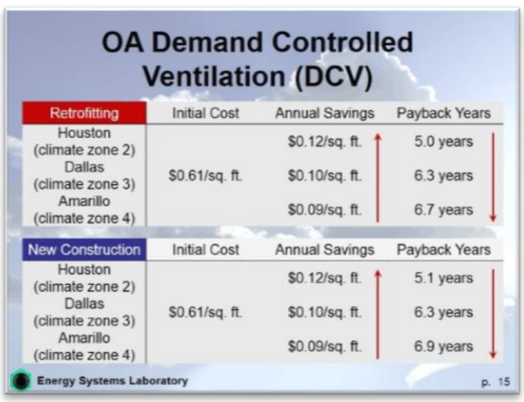
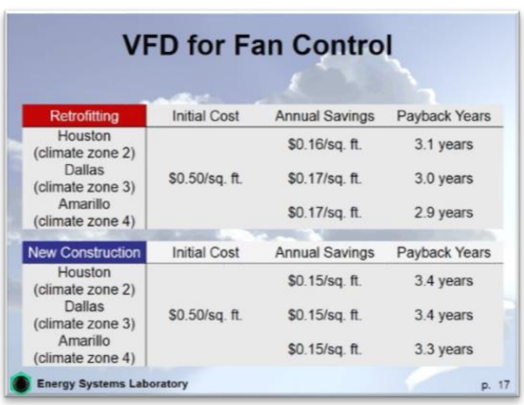


Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)









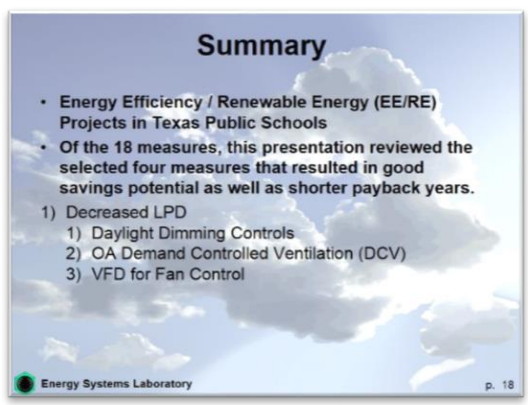
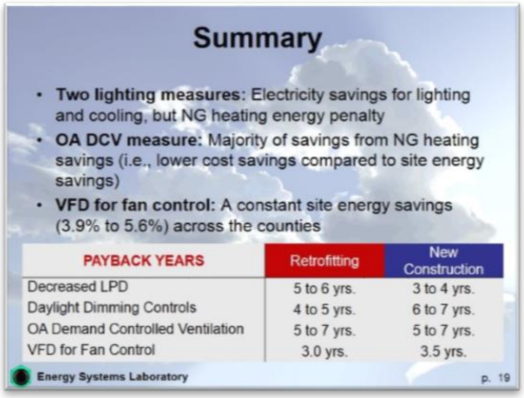


Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)



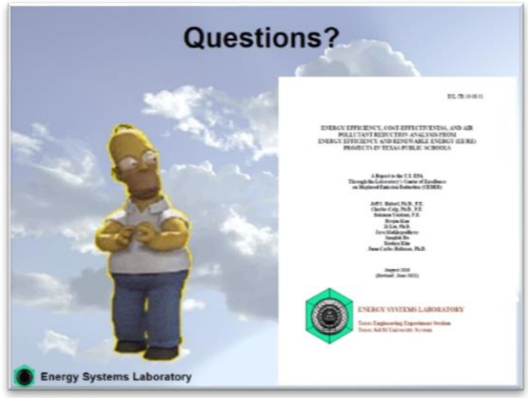


Figure 48: Presentation to the Clean Air Through Energy Efficiency Conference (Continued)

3.6.1 Presented one paper at the 2012 ICEBO Conference in Manchester, UK October 2012

One paper was prepared and presented at the 2012 ICEBO conference in Manchester, UK, October 2012. A copy of this paper has been posted on the Laboratory's TERP web page. Title and abstract for the paper is as follows.

Yazdani, B.; Haberl,J.; Kim, H.; Baltazar, J.C.; Zilbershtein,G. 2012 "Statewide Emissions Reduction, Electricity and Demand Savings from the Implementation of Building-Energy-Codes in Texas," *Proceedings of the 12th International Conference for Enhanced Building Operations,* Manchester, United KingdomThis paper focuses focuses on the estimate of electricity reduction and electric demand savings from the adoption energy codes for single-family residences in Texas, 2002-2009, corresponding increase in cnstruction costs and estimates of the statewide emissions reduction.

4. Calculated NOx Reduction Potential from the Implementation of the 2006 IECC and the ASHRAE Standard 90.1-2007

4.1 Calculated 2012 Electricity and Natural Gas Savings Due to the Implementation of the 2006 IECC to New Residential Construction (Single-family and Multi-family) and the ASHRAE Standard 90.1-2007 to New Commercial Construction Using Code-Traceable, Fuel-Neutral Simulation

A complete reporting of the savings from the implementation of the 2006 IECC and the ASHRAE Standard 90.1-2007 requires tracking and analyzing savings for new construction buildings that undergo a building permit. The adoption of the 2006 IECC and the ASHRAE Standard 90.1-2007 in Texas is expected to impact the following types of buildings:

- single-family residential
- multi-family residential
- commercial
- industrial

The following sections report the calculated energy savings associated with new construction activities for both residential (i.e., single-family and multi-family) and commercial construction. The calculation of energy savings from the adoption of the ASHRAE Standard 90.1-2007 in industrial buildings is currently under development at the Laboratory, and will be reported in future reports.

The following sections report the calculated energy savings associated with new construction activities for both residential (i.e., single-family and multi-family) and commercial construction.

4.1.1 IC3 Enhancements

Most of the enhancements that are being added to IC3 in the recent years are summarized next:

In version 3.12.x (January 2012)

- Deprecated 2000/2001 and 2006 Houston Code.
- Added a button to generate Energy Report w/ a signature line. The original energy report still exists
- Improvements in the algorithm
- Help images/ text updated
- Updated manual

In Version 3.11 (December 2011)

- Added support for IECC 2009 Austin Amendments

In Version 3.10 (September 2011)

- Three IECC 2009 compliant reports (i.e. energy, inspection list, and certificate)
- Paging enhancements on “My Page” to help organize large quantities of projects.
- Multi-family usability increased with Plan/Unit information being displayed on pages.
- Elimination of flash animation (so we will become iPad compatible).
- Updated/expanded help text.
- Updated illustrations.
- Tweaked min/max values on duct insulation, water heaters.

In Version 3.9.x (October 2010)

- Added slab insulation
- Updated the manual

In Version 3.8.x (September 2010)

- Fixed default of Multi-family Units to be “Ducts in Conditioned Space” to YES
- Fixed wrong IECC code version on certificate
- Enhanced input screens by moving several fields from Units to Floor
- Plans

In Version 3.7.x (June 2010)

- Simple multi-family code compliance
- Updated model
    a. Floor Insulation R-Value
    b. Four foundation types
- Updated illustrations
- Updated manual

In Version 3.6.2 (April 2010)

- Fixed defect in 2nd Floor, Back Window issue
- Reference A\C tonnage matches the proposed A\C tonnage.
- Updated model
- Updated illustrations

In Version 3.6.1 (December 2009)

- Foundations
- Opt out of emails
- Copy a project
- Moved orientation from Floors tab to Project Information

In Version 3.5.2 (November 2009)

- Three code choices: IECC 2009, IECC 2006 (with Houston Amendments) and IECC 2000/2001.
- Duct insulation values
- Improved input of overhang values to allow for just inches

4.1.2 Changes in single family input file

There has been one major version change according to the changes in the single family input file since the 2010 annual simulations. Table 2 presents the summarized description of the changes in single family input file since the 2010 annual simulation.

Table 2: Changes in single family input file

BDL Version	Description

4.01.07	BDL used for the 2010 annual report.
4.01.08	Modified cooling and heating Energy-Input-Ratio (EIR) calculation methodology. Corrected door insulation to meet the requirements of 2006 IECC and 2009 IECC.

Version 4.01.08

Modified cooling and heating Energy-Input-Ratio (EIR) calculation methodology

The first change in the input file was to modify cooling and heating Energy-Input-Ratio calculation methodology from SEER and HSPF. The energy efficiency of residential air conditioning systems is rated by the SEER (or HSPF for heat pumps in a heating season) which already includes fan power. Thus if COOLING-EIR or HEATING-EIR for DOE-2.1e inputs are calculated using the nominal SEER or HSPF of the systems, then SUPPLY-KW should be set to zero. Otherwise, if the fan is modeled separately, the fan power should be excluded in the input energy use for EIR calculations.

Since the fan runs continuously during occupied hours in IC3, to model fan power separately is recommended rather than including fan energy in EIRs. Therefore, to determine EIRs for DOE-2 input, the ARI default value of 0.365 W/cfm can be assumed for fan power and subtracted from the input energy for each system (Fairey et al. 2004[13]). Based on 0.365 W/cfm, the following changes were made:

[Version 4.01.07]

```
##SET1 P-SEER sy04
##SET1 P-HSPF sy06

##SET1 P-EIR #[P-COOL-EIR-F[] * #[3.41 / P-SEER[]]]
##SET1 P-HIR #[P-HEAT-EIR-F[] * #[3.41 / P-HSPF[]]]
```

[Version 4.01.08]

```
##SET1 P-SEER sy04
##SET1 P-HSPF sy06

##SET1 P-SEER-NOFAN #[1 / #[#[1 / P-SEER[]] - 0.01095]]
                         $ 0.01095 Wh/Btu = 0.365 W/cfm * 360 cfm/ton * 1 ton/12,000 Btu/h
                         $ Fan power = 0.365 W/cfm (Fairey et al. 2004)

##SET1 P-HSPF-NOFAN #[1 / #[#[1 / P-HSPF[]] - 0.01095]]
                         $ 0.01095 Wh/Btu = 0.365 W/cfm * 360 cfm/ton * 1 ton/12,000 Btu/h
                         $ Fan power = 0.365 W/cfm (Fairey et al. 2004)

##SET1 P-EIR #[P-COOL-EIR-F[] * #[3.41 / P-SEER-NOFAN[]]]
##SET1 P-HIR #[P-HEAT-EIR-F[] * #[3.41 / P-HSPF-NOFAN[]]]
```

Corrected door insulation to meet the requirements of 2006 IECC and 2009 IECC

The change in the input file was to modify glitch in code for door insulation to meet the requirements of 2006 IECC and 2009 IECC performance path analysis. The change in the input file includes assigning door insulation to be

[13] Fairey, P., D.S. Parker, B. Wilcox and M. Lombardi. 2004. Climate Impacts on Heating Seasonal Performance Factor (HSPF) and Seasonal Energy Efficiency Ratio (SEER) for Air Source Heat Pumps. *ASHRAE Transactions* 110(2):178-188.

same as window U-value for a 2006 IECC or 2009 IECC code-compliant house and to be same as user input U-value for a proposed house.

[Version 4.01.07]

```
DOORCON-1 = CONSTRUCTION                    $ MODIFIED BY JAYA M. 06/18/2007
    ##IF #[AMENDMENT[] EQS IC3]             $ TO INCORPORATE REQUIREMENTS FOR DOOR
      U = 0.2                               $ IN IECC2006 / TCV Table 404.5.2 of IECC 2006
    ##ELSEIF #[AMENDMENT[] EQS TCV]
      U = P-WINDOWU[]
    ##ENDIF
```

[Version 4.01.06]

```
DOORCON-1 = CONSTRUCTION                    $ MODIFIED BY JAYA M. 06/18/2007
    ##IF #[P-INPUTMETHOD[] EQS S01]         $ MODIFIED BY H.KIM 03/10/2011
      U = 0.2
    ##ELSEIF #[#[P-INPUTMETHOD[] EQS S06] OR #[P-INPUTMETHOD[] EQS S09]]
      U = P-WINDOWU[]
    ##ELSEIF #[P-INPUTMETHOD[] EQS U]
      U = P-DOORU[]
    ##ENDIF
```

4.1.3 2012 Results for New Single-family Residential Construction

This section provides the potential electricity and natural gas reductions and the associated emissions reductions from the implementation of the 2006 IECC for new single-family residences in the 41 non-attainment and affected counties as well as other counties in the ERCOT region[14]. To calculate the NOx emissions reductions from the implementation of the 2006 IECC, the following procedures were adopted. First, new construction activity was determined by county, and energy savings attributable to the 2006 IECC were calculated using the Laboratory's code-traceable, DOE-2.1e simulation, which was developed for the TERP. These estimates were then applied to the NAHB Builder's survey data to determine the appropriate number of housing types. Then the NOx reduction potential from the electricity and natural gas reductions in each county was calculated using the US EPA's 2010 eGRID database[15].

In Table 3, the 2012 and the 2006 IECC code-compliant building characteristics are shown for each county. The 2012 building characteristics reflect those published by the NAHB, ARI and GAMA for Texas. The 2006 IECC code-compliant characteristics are the minimum building code characteristics required by the 2006 IECC for each county for single-family residences (i.e., Type A.1). In Table 3, the rows are sorted first by the US EPA's non-attainment, affected designation, and then other ERCOT counties alphabetically. Next, in the fourth column, the NAHB Builder's survey classification is listed. The fifth, sixth, seventh, and eighth columns show the NAHB Builder's survey average glazing U-value, Solar Heat Gain Coefficient (SHGC), roof insulation and wall insulation, respectively. In columns nine through twelve, the corresponding values from the 2006 IECC code-compliant house are listed for each county (i.e., glazing U-value, SHGC, roof and wall insulation R-value).

The 2006 IECC SHGC is 0.4 for all non-attainment and affected counties as required by the 2006 IECC. All the 2012 houses were assumed to have air-conditioner efficiency equal to a SEER 13, furnace efficiency (AFUE) of 0.80, and a domestic water heater efficiency of 76%. All the 2006 IECC code-compliant houses were assumed to have air-conditioner efficiency equal to a SEER 13[16]. The values shown in Table 3 represent the only changes that were made to the simulation to obtain the savings calculations. All other variables in the simulation remained the same for the 2012 and the 2006 IECC code-compliant simulation. In cases where the 2012 values were more efficient than the 2006 IECC code-compliant simulation, the 2012 values were used in both simulations, since this indicates that the prevailing practice is already above code. For example, in Collin County, according to the NAHB

[14] The three new counties, Henderson, Hood and Hunt were added in the 2003 Legislative session are included in this.
[15] This preliminary analysis does not include actual power transfers on the grid, and assumes transmission and distribution losses of 7%. Counties were assigned to utility service districts as indicated.
[16] Based on the regulation effective.

Builder's survey data, the wall insulation is R-15.84, which is already above the code-required insulation of R-13. Therefore, R-15.84 was used in both simulations.

The code-traceable simulation results are shown for each county. In a similar fashion as Table 3, Table 4, is first divided into the US EPA's non-attainment and affected classifications, followed by an alphabetical listing of other ERCOT counties. In the third column of Table 4, the 2006 IECC climate zone is listed followed by the number of projected new housing units[17] in the fourth column. In the fifth column, the total simulated energy use is listed if all new construction had been built to pre-code specifications, and, in the sixth column, the total county-wide energy use for code-compliant construction is shown. The values in the fifth and sixth columns come from the associated 24 simulations runs for each county, which were then distributed according to the NAHB Builder's survey data to account for 1 story, 2 story, slab-on-grade, crawlspace, and three different system types. In the seventh column, the total annual electricity savings are shown for each county, respectively. A 7% transmission and distribution loss is used in the 2012 report, which represents a fixed 1.07 multiplier for the electricity use. In the eighth and ninth columns, the total annual pre-code and code-compliant natural gas use is shown for those residences that had natural gas-fired furnaces and domestic water heaters. Finally, in tenth column, the total annual natural gas savings are shown for each county.

In Table 5, the Congestion Management (CM) Zones[18] assignments for each county are shown. In Table 6, the annual electricity savings are assigned to CM Zones provider(s) according to Table 5. The total electricity savings for each CM Zone, as shown in then entered into the bottom row of Table 7, which is the 2010 US EPA's eGRID database[19] for Texas. eGRID then proportions each MWh of electricity savings according to the 2008 measured data from the power plants assigned to that CM Zones. For each county in which there is a power plant the lbs-NOx/MWh are calculated and displayed as NOx reductions (lbs) in the column adjacent to the CM Zones column. Adding across the rows then totals the NOx reductions in each county from multiple CM Zones that have power plants in that county. Counties that do not show NOx reductions represent counties that do not have power plants in eGRID's database.

[17] The number of projected new housing units uses the published values for the new housing units in 2012. A vacancy rate of 0% was assumed for 2012 calculations, based on information suggested by the Real Estate Center at Texas A&M University.
[18] ERCOT region has employed the Congestion Management (CM) since 2010, and it is currently divided into four zones, Houston (H), North (N), South (S), and West (W).
[19] This preliminary analysis does not include actual power transfers on the grid, and assumes transmission and distribution losses of 7%. Counties were assigned to CM Zones as indicated.

Table 3: 2012 and the 2006 IECC Code-compliant Building Characteristics used in the DOE-2 Simulations for Single-family Residential Buildings

	COUNTY	Climate Zone	Division (East or West)	2012 Average Glazing U-value (Btu/hr-ft2-F)	2012 Average SHGC	2012 Average Roof Insulation (hr-ft2-F/Btu)	2012 Average Wall Insulation (hr-ft2-F/Btu)	2006 IECC Glazing U-value (Btu/hr-ft2-F)	2006 IECC SHGC	2006 IECC Roof Insulation (hr-ft2-F/Btu)	2006 IECC Wall Insulation (hr-ft2-F/Btu)
	Brazoria	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Chambers	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Collin	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	Dallas	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	Denton	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	El Paso	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	Fort Bend	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
Non-attainment	Galveston	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Hardin	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Harris	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Jefferson	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Liberty	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Montgomery	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Orange	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Tarrant	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	Waller	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Bastrop	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	Bexar	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	Caldwell	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	Comal	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	Ellis	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	Gregg	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	Guadalupe	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	Harrison	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	Hays	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	Henderson	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	Hood	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	Hunt	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
Affected	Johnson	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	Kaufman	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	Nueces	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Parker	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	Rockwall	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	Rusk	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	San Patricio	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Smith	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	Travis	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	Upshur	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	Victoria	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	Williamson	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	Wilson	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	ANDERSON	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	ANDREWS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	ANGELINA	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	ARANSAS	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	ARCHER	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	ATASCOSA	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	AUSTIN	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	BANDERA	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	BASTROP	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	BAYLOR	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	BEE	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	BELL	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	BEXAR	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	BLANCO	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	BORDEN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	BOSQUE	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	BRAZORIA	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	BRAZOS	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	BREWSTER	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	BRISCOE	4	West Texas	0.44	0.53	25.29	14.74	0.65	NR	30	13.00
	BROOKS	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	BROWN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	BURLESON	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	BURNET	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	CALDWELL	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	CALHOUN	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	CALLAHAN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	CAMERON	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	CHAMBERS	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	CHEROKEE	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	CHILDRESS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	CLAY	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	COKE	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
ERCOT	COLEMAN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	COLLIN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	COLORADO	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	COMAL	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	COMANCHE	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	CONCHO	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	COOKE	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	CORYELL	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	COTTLE	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	CRANE	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	CROCKETT	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	CROSBY	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	CULBERSON	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	DALLAS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	DAWSON	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	DE WITT	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	DELTA	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	DENTON	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	DICKENS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	DIMMIT	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	DUVAL	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	EASTLAND	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	ECTOR	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	EDWARDS	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	ELLIS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	ERATH	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	FALLS	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	FANNIN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	FAYETTE	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	FISHER	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	FOARD	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	FORT BEND	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	FRANKLIN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	FREESTONE	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00

Table 8: 2012 and the 2006 IECC Code-compliant Building Characteristics used in the DOE-2 Simulations for Single-family Residential Buildings (Continued)

	COUNTY	Climate Zone	Division	2012 Average				2006 IECC			
			(East or West)	Glazing U-value (Btu/hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)	Glazing U-value (Btu/hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)
	FRIO	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	GALVESTON	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	GILLESPIE	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	GLASSCOCK	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	GOLIAD	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	GONZALES	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	GRAYSON	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	GRIMES	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	GUADALUPE	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	HALL	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	HAMILTON	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	HARDEMAN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	HARRIS	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	HASKELL	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	HAYS	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	HENDERSON	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	HIDALGO	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	HILL	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	HOOD	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	HOPKINS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	HOUSTON	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	HOWARD	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	HUDSPETH	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	HUNT	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	IRION	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	JACK	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	JACKSON	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	JEFF DAVIS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	JIM HOGG	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	JIM WELLS	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	JOHNSON	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	JONES	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	KARNES	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	KAUFMAN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	KENDALL	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	KENEDY	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	KENT	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	KERR	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	KIMBLE	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	KING	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	KINNEY	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	KLEBERG	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	KNOX	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	LA SALLE	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	LAMAR	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	LAMPASAS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	LAVACA	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	LEE	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	LEON	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	LIMESTONE	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	LIVE OAK	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	LLANO	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	LOVING	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	MADISON	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	MARTIN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	MASON	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	MATAGORDA	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	MAVERICK	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	MCCULLOCH	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	MCLENNAN	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	MCMULLEN	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	MEDINA	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	MENARD	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
ERCOT	MIDLAND	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	MILAM	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	MILLS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	MITCHELL	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	MONTAGUE	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	MONTGOMERY	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	MOTLEY	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	NACOGDOCHES	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	NAVARRO	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	NOLAN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	NUECES	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	PALO PINTO	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	PARKER	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	PECOS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	PRESIDIO	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	RAINS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	REAGAN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	REAL	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	RED RIVER	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	REEVES	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	REFUGIO	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	ROBERTSON	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	ROCKWALL	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	RUNNELS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	RUSK	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	SAN PATRICIO	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	SAN SABA	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	SCHLEICHER	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	SCURRY	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	SHACKELFORD	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	SMITH	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	SOMERVELL	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	STARR	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	STEPHENS	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	STERLING	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	STONEWALL	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	SUTTON	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	TARRANT	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	TAYLOR	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	TERRELL	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	THROCKMORTON	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	TITUS	3	East Texas	0.44	0.53	28.17	14.56	0.65	0.40	30	13.00
	TOM GREEN	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	TRAVIS	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	UPTON	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	UVALDE	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	VAL VERDE	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	VAN ZANDT	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	VICTORIA	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	WALLER	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	WARD	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	WASHINGTON	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	WEBB	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	WHARTON	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	WICHITA	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	WILBARGER	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	WILLACY	2	East Texas	0.44	0.53	28.17	14.56	0.75	0.40	30	13.00
	WILLIAMSON	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	WILSON	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	WINKLER	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	WISE	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	YOUNG	3	West Texas	0.44	0.53	25.29	14.74	0.65	0.40	30	13.00
	ZAPATA	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00
	ZAVALA	2	West Texas	0.44	0.53	25.29	14.74	0.75	0.40	30	13.00

Table 4: 2012 Annual Electricity Savings from Implementation of the 2006 IECC for Single-family Residences Using 2008 Base Year

	2012 Summary TRY 2008								
	County	Climate Zone	No. of Projected Units (2012)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Total Annual NG Savings (Therm/yr)
Nonattain-ment County	BRAZORIA	3	1,922	26,313	24,878	**1,536**	381,744	360,227	**21,517**
	CHAMBERS	4	293	3,921	3,712	**223**	60,017	56,923	**3,093**
	COLLIN	6	6,140	105,744	99,157	**7,047**	909,058	805,413	**103,645**
	DALLAS	5	3,531	60,753	56,972	**4,046**	525,111	465,091	**60,019**
	DENTON	6	3,460	59,588	55,877	**3,971**	512,271	453,865	**58,406**
	EL PASO	6	3,176	48,545	45,758	**2,982**	534,714	467,193	**67,521**
	FORT BEND	4	6,517	89,240	84,365	**5,216**	1,292,872	1,221,436	**71,436**
	GALVESTON	3	1,784	24,424	23,092	**1,426**	354,334	334,363	**19,972**
	HARDIN	4	95	1,272	1,204	**72**	19,456	18,418	**1,038**
	HARRIS	4	14,550	199,239	188,355	**11,646**	2,886,496	2,727,005	**159,491**
	JEFFERSON	4	539	7,218	6,833	**412**	110,386	104,498	**5,889**
	LIBERTY	4	165	2,261	2,137	**132**	32,733	30,886	**1,847**
	MONTGOMERY	4	3,364	46,064	43,548	**2,693**	667,366	630,491	**36,875**
	ORANGE	4	184	2,464	2,333	**141**	37,640	35,673	**1,967**
	TARRANT	5	4,640	79,834	74,865	**5,316**	690,035	611,165	**78,870**
	WALLER	4	8	110	104	**6**	1,587	1,499	**88**
Affected County	BASTROP	4	44	649	611	**41**	11,552	10,232	**1,320**
	BEXAR	4	2,873	45,265	42,930	**2,498**	298,946	267,787	**31,158**
	CALDWELL	4	6	100	94	**6**	772	684	**88**
	COMAL	4	1,130	17,803	16,885	**983**	117,580	105,325	**12,255**
	ELLIS	5	643	11,063	10,375	**737**	95,623	84,694	**10,930**
	GREGG	6	228	3,413	3,217	**210**	60,692	57,375	**3,317**
	GUADALUPE	4	730	11,501	10,908	**635**	75,959	68,042	**7,917**
	HARRISON	6	36	537	507	**33**	9,679	9,132	**547**
	HAYS	5	1,426	23,686	22,255	**1,530**	182,987	162,317	**20,670**
	HENDERSON	5	146	2,176	2,053	**132**	39,352	37,134	**2,219**
	HOOD	5	113	1,944	1,823	**129**	16,805	14,884	**1,921**
	HUNT	6	26	448	420	**30**	3,858	3,419	**439**
	JOHNSON	5	558	9,601	9,003	**639**	82,983	73,498	**9,485**
	KAUFMAN	6	219	3,772	3,537	**251**	32,424	28,727	**3,697**
	NUECES	3	1,014	14,665	13,801	**924**	178,233	168,899	**9,334**
	PARKER	6	189	3,255	3,052	**217**	27,982	24,792	**3,190**
	ROCKWALL	6	675	11,625	10,901	**775**	99,937	88,543	**11,394**
	RUSK	5	4	54	51	**3**	961	903	**58**
	SAN PATRICIO	3	170	2,459	2,314	**155**	29,881	28,316	**1,565**
	SMITH	5	228	3,398	3,206	**206**	61,454	57,989	**3,465**
	TRAVIS	5	4,428	73,548	69,107	**4,751**	568,211	504,025	**64,186**
	UPSHUR	6	13	199	187	**13**	3,946	3,492	**454**
	VICTORIA	3	111	1,554	1,466	**94**	21,980	20,736	**1,244**
	WILLIAMSON	5	2,357	39,149	36,786	**2,529**	302,455	268,290	**34,166**
	WILSON	4	27	425	403	**23**	2,809	2,517	**293**
ERCOT	ANDERSON	5	6	80	76	**5**	1,441	1,354	**87**
	ANDREWS	6	54	895	844	**55**	8,946	7,877	**1,068**
	ANGELINA	5	55	737	696	**44**	13,211	12,413	**799**
	ARANSAS	3	89	1,287	1,211	**81**	15,644	14,824	**819**
	ARCHER	7	4	70	66	**4**	781	684	**96**
	ATASCOSA	3	58	903	860	**46**	5,705	5,081	**624**
	AUSTIN	4	21	288	272	**17**	4,166	3,936	**230**
	BANDERA	5	0	0	0	**0**	0	0	**0**
	BAYLOR	7	0	0	0	**0**	0	0	**0**
	BEE	3	9	126	119	**8**	1,782	1,681	**101**
	BELL	5	1,846	29,817	28,280	**1,644**	269,749	237,123	**32,625**
	BLANCO	5	2	33	31	**2**	257	228	**29**
	BORDEN	7	19	271	256	**16**	9,220	8,090	**1,130**
	BOSQUE	5	2	32	31	**2**	292	257	**35**
	BRAZOS	4	727	9,955	9,411	**582**	144,226	136,257	**7,969**
	BREWSTER	5	7	116	109	**7**	1,013	891	**122**
	BRISCOE	8	7	130	122	**9**	2,256	1,985	**271**
	BROOKS	2	0	0	0	**0**	0	0	**0**
	BROWN	5	57	921	873	**51**	8,329	7,322	**1,007**
	BURLESON	4	35	479	453	**28**	6,943	6,560	**384**
	BURNET	5	168	2,790	2,622	**180**	21,558	19,123	**2,435**
	CALHOUN	3	64	896	845	**54**	12,673	11,956	**717**
	CALLAHAN	6	7	117	110	**7**	1,168	1,032	**136**
	CAMERON	2	1,012	15,103	14,189	**978**	143,069	135,308	**7,761**
	CHEROKEE	5	18	241	228	**14**	4,324	4,062	**261**
	CHILDRESS	7	0	0	0	**0**	0	0	**0**
	CLAY	7	1	18	17	**1**	195	171	**24**
	COKE	6	1	17	16	**1**	145	127	**18**
	COLEMAN	5	1	17	16	**1**	167	148	**19**
	COLORADO	4	15	205	194	**12**	2,976	2,811	**164**
	COMANCHE	5	1	16	15	**1**	146	128	**18**
	CONCHO	5	1	17	16	**1**	145	127	**17**
	COOKE	6	37	637	597	**42**	5,491	4,866	**625**
	CORYELL	5	206	3,327	3,156	**183**	30,102	26,461	**3,641**
	COTTLE	7	0	0	0	**0**	0	0	**0**
	CRANE	5	4	66	63	**4**	664	584	**80**
	CROCKETT	5	19	315	297	**19**	2,750	2,419	**332**
	CROSBY	7	8	114	108	**7**	3,882	3,406	**476**
	CULBERSON	6	1	15	14	**1**	163	141	**21**
	DAWSON	7	6	167	158	**10**	5,530	4,829	**701**
	DE WITT	3	4	56	53	**3**	792	747	**45**
	DELTA	6	4	69	65	**5**	592	525	**68**
	DICKENS	7	0	0	0	**0**	0	0	**0**
	DIMMIT	3	5	79	75	**4**	428	388	**40**
	DUVAL	3	0	0	0	**0**	0	0	**0**
	EASTLAND	6	0	0	0	**0**	0	0	**0**
	ECTOR	6	581	9,633	9,085	**587**	96,250	84,755	**11,494**
	EDWARDS	5	0	0	0	**0**	0	0	**0**
	ERATH	6	46	766	724	**46**	7,674	6,780	**895**
	FALLS	5	6	97	92	**5**	877	771	**106**
	FANNIN	6	18	310	291	**21**	2,671	2,367	**304**
	FAYETTE	4	4	55	52	**3**	794	750	**44**
	FISHER	6	0	0	0	**0**	0	0	**0**
	FOARD	7	0	0	0	**0**	0	0	**0**
	FRANKLIN	6	0	0	0	**0**	0	0	**0**
	FREESTONE	5	10	162	153	**9**	1,461	1,285	**177**
	FRIO	3	31	483	460	**25**	3,049	2,716	**333**

Table 9: 2012 Annual Electricity Savings from Implementation of the 2006 IECC for Single-family Residences Using 2008 Base Year (Continued)

	2012 Summary TRY 2008								
	County	Climate Zone	No. of Projected Units (2012)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Total Annual NG Savings (Therm/yr)
	GILLESPIE	5	34	565	531	**36**	4,363	3,870	**493**
	GLASSCOCK	6	0	0	0	**0**	0	0	**0**
	GOLIAD	3	0	0	0	**0**	0	0	**0**
	GONZALES	4	1	16	15	**1**	104	93	**11**
	GRAYSON	6	71	1,222	1,146	**81**	10,536	9,337	**1,200**
	GRIMES	4	25	342	324	**20**	4,960	4,686	**274**
	HALL	8	0	0	0	**0**	0	0	**0**
	HAMILTON	5	2	32	31	**2**	292	257	**35**
	HARDEMAN	7	0	0	0	**0**	0	0	**0**
	HASKELL	6	2	33	31	**2**	334	295	**39**
	HIDALGO	2	2,866	42,772	40,182	**2,771**	405,174	383,194	**21,979**
	HILL	5	2	32	31	**2**	292	257	**35**
	HOPKINS	6	9	155	145	**10**	1,332	1,181	**152**
	HOUSTON	5	5	67	63	**4**	1,201	1,128	**73**
	HOWARD	6	15	249	235	**15**	2,485	2,188	**297**
	HUDSPETH	6	0	0	0	**0**	0	0	**0**
	IRION	5	0	0	0	**0**	0	0	**0**
	JACK	6	10	167	157	**10**	1,668	1,474	**194**
	JACKSON	3	10	140	132	**8**	1,980	1,868	**112**
	JEFF DAVIS	6	0	0	0	**0**	0	0	**0**
	JIM HOGG	2	0	0	0	**0**	0	0	**0**
	JIM WELLS	3	35	506	476	**32**	6,152	5,830	**322**
	JONES	6	0	0	0	**0**	0	0	**0**
	KARNES	3	61	944	899	**48**	6,060	5,410	**650**
	KENDALL	5	271	4,224	4,022	**217**	26,595	23,677	**2,918**
	KENEDY	2	0	0	0	**0**	0	0	**0**
	KENT	7	0	0	0	**0**	0	0	**0**
	KERR	5	46	764	718	**49**	5,903	5,236	**667**
	KIMBLE	5	0	0	0	**0**	0	0	**0**
	KING	7	0	0	0	**0**	0	0	**0**
	KINNEY	4	0	0	0	**0**	0	0	**0**
	KLEBERG	2	19	273	257	**17**	3,105	2,930	**175**
	KNOX	7	0	0	0	**0**	0	0	**0**
	LA SALLE	3	5	79	75	**4**	428	388	**40**
	LAMAR	6	11	163	154	**9**	2,826	2,659	**167**
	LAMPASAS	5	7	113	107	**6**	1,023	899	**124**
	LAVACA	4	17	237	223	**14**	3,152	2,961	**191**
	LEE	4	47	781	734	**50**	6,047	5,360	**687**
	LEON	5	0	0	0	**0**	0	0	**0**
	LIMESTONE	5	1	16	15	**1**	146	128	**18**
	LIVE OAK	3	13	188	177	**12**	2,285	2,165	**120**
	LLANO	5	37	615	577	**40**	4,748	4,212	**536**
	LOVING	6	0	0	0	**0**	0	0	**0**
	MADISON	4	34	466	440	**27**	6,745	6,372	**373**
	MARTIN	6	4	66	63	**4**	663	584	**79**
	MASON	5	3	50	47	**3**	385	341	**43**
	MATAGORDA	3	71	994	938	**60**	14,059	13,263	**796**
	MAVERICK	3	75	1,180	1,125	**59**	6,415	5,818	**597**
	MCCULLOCH	5	0	0	0	**0**	0	0	**0**
	MCLENNAN	5	489	7,899	7,491	**436**	71,456	62,813	**8,642**
	MCMULLEN	3	0	0	0	**0**	0	0	**0**
ERCOT	MEDINA	4	14	221	209	**12**	1,457	1,305	**152**
	MENARD	5	0	0	0	**0**	0	0	**0**
	MIDLAND	6	599	9,932	9,366	**605**	99,231	87,381	**11,850**
	MILAM	4	3	46	43	**2**	299	268	**31**
	MILLS	5	0	0	0	**0**	0	0	**0**
	MITCHELL	6	4	67	63	**4**	667	590	**78**
	MONTAGUE	6	10	172	161	**11**	1,484	1,315	**169**
	MOTLEY	7	0	0	0	**0**	0	0	**0**
	NACOGDOCHES	5	38	509	481	**31**	9,128	8,576	**552**
	NAVARRO	5	74	1,195	1,134	**66**	10,813	9,505	**1,308**
	NOLAN	6	1	17	16	**1**	167	147	**19**
	PALO PINTO	6	9	150	142	**9**	1,501	1,326	**175**
	PECOS	5	6	99	94	**6**	869	764	**105**
	PRESIDIO	5	3	50	47	**3**	434	382	**52**
	RAINS	6	2	34	32	**2**	296	262	**34**
	REAGAN	5	2	33	31	**2**	332	292	**40**
	REAL	5	0	0	0	**0**	0	0	**0**
	RED RIVER	6	7	104	98	**6**	1,798	1,692	**106**
	REEVES	6	2	33	31	**2**	331	292	**40**
	REFUGIO	3	10	140	132	**8**	1,980	1,868	**112**
	ROBERTSON	4	22	301	285	**18**	4,364	4,123	**241**
	RUNNELS	5	0	0	0	**0**	0	0	**0**
	SAN SABA	5	0	0	0	**0**	0	0	**0**
	SCHLEICHER	5	5	83	78	**5**	724	636	**87**
	SCURRY	7	51	726	687	**42**	24,748	21,714	**3,033**
	SHACKELFORD	6	0	0	0	**0**	0	0	**0**
	SOMERVELL	5	6	103	97	**7**	892	790	**102**
	STARR	2	2	30	28	**2**	283	267	**15**
	STEPHENS	6	3	50	47	**3**	500	442	**58**
	STERLING	6	0	0	0	**0**	0	0	**0**
	STONEWALL	7	0	0	0	**0**	0	0	**0**
	SUTTON	5	0	0	0	**0**	0	0	**0**
	TAYLOR	6	234	3,898	3,681	**233**	39,038	34,488	**4,551**
	TERRELL	5	0	0	0	**0**	0	0	**0**
	THROCKMORTO	6	0	0	0	**0**	0	0	**0**
	TITUS	6	13	192	182	**11**	3,340	3,142	**198**
	TOM GREEN	5	229	3,792	3,574	**233**	33,149	29,150	**3,999**
	UPTON	5	7	116	110	**7**	1,162	1,021	**141**
	UVALDE	4	21	331	314	**18**	2,185	1,957	**228**
	VAL VERDE	4	29	457	433	**25**	3,018	2,703	**315**
	VAN ZANDT	6	5	86	81	**6**	740	656	**84**
	WARD	6	10	166	156	**10**	1,657	1,459	**198**
	WASHINGTON	4	35	479	453	**28**	6,943	6,560	**384**
	WEBB	3	750	11,797	11,245	**590**	64,150	58,176	**5,974**
	WHARTON	3	76	1,064	1,004	**64**	15,049	14,197	**852**
	WICHITA	7	118	2,073	1,954	**127**	23,031	20,192	**2,839**
	WILBARGER	7	0	0	0	**0**	0	0	**0**
	WILLACY	2	37	552	519	**36**	5,231	4,947	**284**
	WINKLER	6	2	33	31	**2**	331	292	**40**
	WISE	6	29	499	468	**33**	4,294	3,804	**490**
	YOUNG	6	29	483	456	**29**	4,838	4,274	**564**
	ZAPATA	2	0	0	0	**0**	0	0	**0**
	ZAVALA	3	7	110	105	**6**	599	543	**56**
	TOTAL		**79,841**			**75,591**			**1,086,928**

Table 5: Allocation of CM Zones for each of Applicable ERCOT Counties[20]

[20] Of a total of 202 counties, 138 counties are not included in this table since the corresponding providers could not be assigned for these 138 counties.

County	Plant	CM Zones Percentage			
		H	N	W	S
Andrews	Fullerton	0.10	0.58	99.31	0.01
Atascosa	San Miguel	11.04	0.74	0.04	88.18
Bastrop	Bastrop Energy Center Lost Pines 1 Power Project Sim Gideon 1 Sim Gideon 2 Sim Gideon 3	11.04	0.74	0.04	88.18
Bexar	Arthur Von Rosenberg Covel Gardens J K Spruce J K Spruce 2 J T Deely 1 J T Deely 2 Leon Creek O W Sommers 1 O W Sommers 2 University of Texas at San Antonio V H Braunig 1 V H Braunig 2 V H Braunig 3 V H Braunig 6 W B Tuttle	11.04	0.74	0.04	88.18
Bosque	Bosque County Peaking	13.35	81.87	3.95	0.84
Brazoria	BASF Freeport Works Chocolate Bayou Plant Chocolate Bayou Works Dow Chemical Texas Operation Freeport Energy Center (expansion) Oyster Creek Unit VIII Sweeny Cogen Facility	99.06	0.01	0.00	0.93
Brazos	Bryan 3 Bryan 4 Bryan 5 Bryan 6 Bryan 7 Dansby 1 Dansby 2 Dansby 3	13.09	72.93	3.52	10.45
Calhoun	Point Comfort Operations Seadrift Coke LP Union Carbide Seadrift Cogen	11.04	0.74	0.04	88.18
Cameron	La Palma 4 La Palma 5 La Palma 6 La Palma 7 Silas Ray	11.04	0.74	0.04	88.18
Chambers	Baytown Energy Center Cedar Bayou 1 Cedar Bayou 2 Enterprise Products Operating	99.06	0.01	0.00	0.93
Cherokee	Stryker Creek 1 Stryker Creek 2 Stryker Creek 3	13.35	81.87	3.95	0.84
Coke	Jameson Gas Processing Plant	0.00	0.00	0.00	0.00
Collin	Ray Olinger 2 Ray Olinger 3 Ray Olinger 4 Ray Olinger 5 University of Texas at Dallas	13.35	81.87	3.95	0.84
Dallas	C E Newman Lake Hubbard 1 Lake Hubbard 2 Mountain Creek State Farm Insur Support Center Central	13.35	81.87	3.95	0.84
Denton	Spencer 4 Spencer 5	13.35	81.87	3.95	0.84
Ector	Odessa Ector Generating Station Quail Run Energy Center Quail Run Energy Center Quail Run Energy Center	0.97	0.60	91.36	7.07
Ellis	Ennis Tractebel Power LP Midlothian Energy Facility	13.35	81.87	3.95	0.84
Fannin	Valley	13.35	81.87	3.95	0.84
Fayette	Fayette Power Project Winchester Power Park	11.89	30.55	1.48	56.09
Fort Bend	Brazos Valley Generating Facility W A Parish 1 W A Parish 2 W A Parish 3 W A Parish 4 W A Parish 5 W A Parish 7 (Uprated) W A Parish 8 W A Parish GT1	99.06	0.01	0.00	0.93
Freestone	Big Brown 1 (Upgrade) Big Brown 2 Freestone Power Generation LP	13.35	81.87	3.95	0.84
Frio	Pearsall 1 Pearsall 2 Pearsall 3	0.10	0.58	99.31	0.01
Galveston	Green Power 2 P H Robinson Power Station 4 S&L Cogeneration Texas City Plant Union Carbide Texas City Power Plant Valero Refining Texas City	99.06	0.01	0.00	0.93
Goliad	Coleto Creek	0.00	0.00	0.00	0.00
Grimes	Gibbons Creek	0.00	0.00	0.00	0.00
Guadalupe	Guadalupe Generating Station Rio Nogales Power Project	11.04	0.74	0.04	88.18

Table 10: Allocation of CM Zones for each of Applicable ERCOT Counties (Continued)[21]

[21] Of a total of 202 counties, 138 counties are not included in this table since the corresponding providers could not be assigned for these 138 counties.

County	Plant	CM Zones Percentage			
		H	N	W	S
Harris	AES Deepwater	99.06	0.01	0.00	0.93
	Altura Cogen				
	Bayou Cogen Plant				
	Cedar Bayou 4				
	Channel Energy Center				
	Channelview Cogeneration Plant				
	Clear Lake Cogeneration Ltd				
	Deepwater				
	Deer Creek Energy Center				
	Deer Park Energy Center				
	Exelon LaPorte Generating Station				
	ExxonMobil Baytown Refinery				
	ExxonMobil Baytown Turbine				
	Greens Bayou 5				
	Greens Bayou Others				
	Hiram Clarke				
	Houston Chemical Complex Battleground				
	Pasadena				
	Pasadena Cogeneration				
	Rice University				
	Sam Bertron 1				
	Sam Bertron 2				
	Sam Bertron 3				
	Sam Bertron 4				
	Sam Bertron Others				
	San Jacinto Steam Electric Station				
	Shell Deer Park				
	T H Wharton				
	Texas Medical Center				
	Texas Petrochemicals				
	Valero Refining Texas Houston				
	Webster				
	Westhollow Technology Center				
Hays	Hays Energy Project	11.04	0.74	0.04	88.18
	Southwest Texas State University				
Henderson	Trinidad	13.35	81.87	3.95	0.84
Hidalgo	Frontera Energy Center	11.04	0.74	0.04	88.18
	Hidalgo Energy Center				
	J L Bates 1				
	J L Bates 2				
	Magic Valley Generating Station				
Hood	DeCordova Steam Electric Station 1	13.35	81.87	3.95	0.84
	DeCordova Steam Electric Station CTs				
	Wolf Hollow I, L.P.				
Howard	Big Spring Carbon Plant	0.20	0.59	98.34	0.87
	C R Wing Cogen Plant				
Hunt	Engine Plant	11.08	2.24	0.11	86.57
	Greenville				
	Powerlane Plant				
Jack	Jack County Project	13.35	81.87	3.95	0.84
	Jack Energy Facility				
Johnson	Johnson County	13.35	81.87	3.95	0.84
Kaufman	Forney Energy Center	13.35	81.87	3.95	0.84
Lamar	Lamar Power Project	13.35	81.87	3.95	0.84
	Paris Generating Station				
Limestone	Limestone 1	0.00	0.00	0.00	0.00
	Limestone 2 (Uprated)				
Llano	Thomas C Ferguson	11.04	0.74	0.04	88.18
McLennan	Baylor University Cogen	13.35	81.87	3.95	0.84
	Lake Creek				
	Tradinghouse 1				
	Tradinghouse 2				
Milam	Sandow 5	11.04	0.74	0.04	88.18
	Sandow No 4				
	Sandow Station				
Mitchell	Morgan Creek	0.10	0.58	99.31	0.01
Nolan	TXU Sweetwater Generating Plant	0.10	0.58	99.31	0.01
Nueces	Barney M. Davis 1	11.04	0.74	0.04	88.18
	Barney M. Davis 2				
	Barney M. Davis Power Plant (repowering)				
	Celanese Engineering Resin				
	Corpus Christi				
	Corpus Christi Energy Center				
	Corpus Refinery				
	Nueces Bay Power Plant (repowering)				
	Valero Refinery Corpus Christi East				
	Valero Refinery Corpus Christi West				
Palo Pinto	R W Miller 1	13.35	81.87	3.95	0.84
	R W Miller 2				
	R W Miller 3				
	R W Miller Others				
Parker	North Texas	13.35	81.87	3.95	0.84
	Weatherford				
Pecos	Yates Gas Plant	0.10	0.58	99.31	0.01
Reagan	Midkiff Plant	0.10	0.58	99.31	0.01
Robertson	Oak Grove 1	11.34	11.28	0.55	76.83
	Oak Grove 2				
	Twin Oaks Power One 1				
	Twin Oaks Power One 2				
Rusk	Martin Lake	0.00	0.00	0.00	0.00
San Patricio	Gregory Power Facility	11.04	0.74	0.04	88.18
	Ingleside Cogeneration				
Scurry	EG178 Facility	0.10	0.58	99.31	0.01
Tarrant	Eagle Mountain	13.35	81.87	3.95	0.84
	Handley				
Titus	Monticello	0.00	0.00	0.00	0.00

Table 10: Allocation of CM Zones for each of Applicable ERCOT Counties (Continued)[22]

[22] Of a total of 202 counties, 138 counties are not included in this table since the corresponding providers could not be assigned for these 138 counties.

County	Plant	CM Zones Percentage			
		H	N	W	S
Travis	Central Utility Plant	11.04	0.74	0.04	88.18
	Decker Creek 1				
	Decker Creek 2				
	Decker Creek GT (1-4)				
	Hal C Weaver Pow er Plant				
	Holly Street 3				
	Holly Street 4				
	Mueller Energy Center				
	Sand Hill				
Upton	Benedum Plant	0.10	0.58	99.31	0.01
Victoria	Sam Rayburn	11.04	0.74	0.04	88.18
	Victoria (refurbish)				
	Victoria Texas Plant				
Ward	Permian Basin 5	0.10	0.58	99.31	0.01
	Permian Basin 6				
	Permian Basin Others				
Webb	Laredo 1	11.04	0.74	0.04	88.18
	Laredo 2				
	Laredo 3				
	Laredo Energy Center (refurbish)				
Wharton	Colorado Bend Energy Center	11.04	0.74	0.04	88.18
	Colorado Bend Energy Center				
	Colorado Bend Energy Center				
	New gulf Cogen				
Wichita	PPG Industries Works 4	0.10	0.58	99.31	0.01
	Signal Hill Wichita Falls Pow er LP				
Wilbarger	Oklaunion	13.35	81.87	3.95	0.84
Wise	Bridgeport Gas Processing Plant	13.35	81.87	3.95	0.84
	Wise County Pow er LP				
Young	Graham 1	13.35	81.87	3.95	0.84
	Graham 2				

Table 6: 2012 Totalized Annual Electricity Savings from the 2006 IECC by CM Zones for Single-family Residences Using 2008 Base Year

CM Zones	Total Electricity Savings by CM Zones (MWh) 2012-TRY 2008
H	24,698.00
N	19,425.06
W	1,765.47
S	13,902.28
Total	59,790.81

Table 7: 2012 Annual NOx Reductions from the 2006 IECC by CM Zones for Single-family Residences by County Using 2010 eGRID

Area	County	H	NOx Reductions (lbs)	N	NOx Reductions (lbs)	W	NOx Reductions (lbs/year)	S	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.0562032	1388.1066228	0.0000071	0.1385114	0.0000003	0.0006081	0.0005265	7.3201351	1395.5658773	0.6977829
	Chambers	0.0204500	505.0742533	0.0000026	0.0503985	0.0000001	0.0002212	0.0001916	2.6634926	507.7883658	0.2538942
	Fort Bend	0.0313463	774.1915047	0.0000040	0.0772522	0.0000002	0.0003391	0.0002937	4.0826737	778.3517698	0.3891759
	Galveston	0.0226620	559.7052534	0.0000029	0.0558498	0.0000001	0.0002452	0.0002123	2.9515874	562.7129359	0.2813565
	Harris	0.1486911	3672.3734775	0.0000189	0.3664455	0.0000009	0.0016087	0.0013930	19.3661420	3692.1076738	1.8460538
Dallas/ Fort Worth Area	Collin	0.0012932	31.9386656	0.0079329	154.0975872	0.0003832	0.6764834	0.0000809	1.1251766	187.8379127	0.0939190
	Dallas	0.0024826	61.3154645	0.0152295	295.8346873	0.0007356	1.2987047	0.0001554	2.1601004	360.6089569	0.1803045
	Denton	0.0001267	3.1283363	0.0007770	15.0935883	0.0000375	0.0662604	0.0000079	0.1102091	18.3983940	0.0091992
	Tarrant	0.0004742	11.7113641	0.0029089	56.5049578	0.0001405	0.2480549	0.0000297	0.4125831	68.8769599	0.0344385
	Ellis	0.0029920	73.8962260	0.0183544	356.5343113	0.0008865	1.5651741	0.0001873	2.6033117	434.5990231	0.2172995
	Johnson	0.0007256	17.9208433	0.0044512	86.4644363	0.0002150	0.3795761	0.0000454	0.6313386	105.3961942	0.0526981
	Kaufman	0.0059718	147.4927165	0.0366343	711.6224597	0.0017695	3.1239996	0.0003738	5.1960639	867.4352397	0.4337176
	Parker	0.0000012	0.0303667	0.0000075	0.1465132	0.0000004	0.0006432	0.0000001	0.0010698	0.1785928	0.0000893
	Henderson	0.0006908	17.0607919	0.0042376	82.3148624	0.0002047	0.3613596	0.0000432	0.6010396	100.3380535	0.0501690
	Hood	0.0050771	125.3941104	0.0311454	605.0011648	0.0015044	2.6559356	0.0003178	4.4175456	737.4687564	0.3687344
	Hunt	0.0088463	218.4868086	0.0047066	91.4266898	0.0002273	0.4013602	0.0652823	907.5727097	1217.8875683	0.6089438
San Antonio Area	Bexar	0.0138906	343.0701737	0.0009368	18.1976623	0.0000452	0.0798871	0.1109355	1542.2568925	1903.6046156	0.9518023
	Guadalupe	0.0032029	79.1049593	0.0002160	4.1960084	0.0000104	0.0184203	0.0255795	355.6128691	438.9322572	0.2194661
Austin Area	Bastrop	0.0033782	83.4353783	0.0002278	4.4257092	0.0000110	0.0194287	0.0269798	375.0800771	462.9605933	0.2314803
	Hays	0.0008331	20.5766171	0.0000562	1.0914570	0.0000027	0.0047915	0.0066537	92.5012782	114.1741438	0.0570871
	Travis	0.0051785	127.8994665	0.0003493	6.7842426	0.0000169	0.0297826	0.0413577	574.9664322	709.6799240	0.3548400
	Rusk	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Corpus Christi Area	Nueces	0.0128578	317.5614250	0.0008672	16.8445875	0.0000419	0.0739472	0.1026870	1427.5834336	1762.0633933	0.8810317
	San Patricio	0.0015100	37.2928358	0.0001018	1.9781447	0.0000049	0.0086840	0.0120591	167.6483046	206.9279690	0.1034640
Victoria Area	Victoria	0.0021192	52.3389111	0.0001429	2.7762420	0.0000069	0.0121876	0.0169244	235.2872752	290.4146159	0.1452073
Other ERCOT counties	Andrews	0.0000037	0.0924754	0.0000230	0.4461749	0.0039003	6.8858355	0.0000002	0.0032578	7.4277436	0.0037139
	Bosque	0.0022204	54.8400360	0.0136212	264.5920572	0.0006579	1.1615506	0.0001390	1.9319756	322.5256194	0.1612628
	Brazos	0.0024089	59.4944547	0.0112305	218.1534272	0.0005425	0.9576865	0.0047829	66.4933338	345.0989022	0.1725495
	Calhoun	0.0009466	23.3787031	0.0000638	1.2400896	0.0000031	0.0054440	0.0075598	105.0979328	129.7221694	0.0648611
	Cameron	0.0063536	156.9219726	0.0004285	8.3236996	0.0000207	0.0365408	0.0507425	705.4358333	870.7180463	0.4353590
	Cherokee	0.0027392	67.6516587	0.0168033	326.4055401	0.0008116	1.4329098	0.0001714	2.3833200	397.8734286	0.1989367
	Coke	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Ector	0.0019215	47.4574158	0.0006604	12.8274333	0.0911346	160.8958683	0.0146527	203.7057075	424.8864249	0.2124432
	Fannin	0.0000041	0.1001483	0.0000249	0.4831953	0.0000012	0.0021212	0.0000003	0.0035282	0.5889930	0.0002945
	Fayette	0.0051867	128.1011754	0.0103217	200.4991620	0.0004986	0.8801848	0.0283993	394.8150885	724.2956107	0.3621478
	Freestone	0.0047643	117.6696433	0.0292268	567.7321765	0.0014117	2.4923259	0.0002982	4.1454181	692.0395638	0.3460198
	Frio	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Grimes	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Hidalgo	0.0053716	132.6671761	0.0003623	7.0371389	0.0000175	0.0308928	0.0428994	596.3994610	736.1346687	0.3680673
	Howard	0.0002411	5.9551271	0.0007641	14.8421083	0.1283942	226.6766024	0.0009490	13.1931389	260.6669766	0.1303335
	Jack	0.0030783	76.0281857	0.0188839	366.8205845	0.0009121	1.6103305	0.0001927	2.6784191	447.1375198	0.2235688
	Lamar	0.0040001	98.7955048	0.0245388	476.6682842	0.0011853	2.0925584	0.0002504	3.4804956	581.0368430	0.2905184
	Limestone	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Llano	0.0040314	99.5686917	0.0002719	5.2814776	0.0000131	0.0231855	0.0321966	447.6066788	552.4800336	0.2762400
	McLennan	0.0056576	139.7319595	0.0347066	674.1783801	0.0016764	2.9596213	0.0003541	4.9226579	821.7926188	0.4108963
	Milam	0.0012686	31.3320378	0.0000856	1.6619627	0.0000041	0.0072960	0.0101316	140.8517993	173.8530958	0.0869265
	Mitchell	0.0000311	0.7688184	0.0001910	3.7093929	0.0324260	57.2472142	0.0000019	0.0270849	61.7525105	0.0308763
	Nolan	0.0000293	0.7225487	0.0001795	3.4861508	0.0304745	53.8019097	0.0000018	0.0254549	58.0360641	0.0290180
	Palo Pinto	0.0036129	89.2323584	0.0221635	430.5280413	0.0010705	1.8900042	0.0002261	3.1435927	524.7939966	0.2623970
	Pecos	0.0000020	0.0486536	0.0000121	0.2347435	0.0020520	3.6228067	0.0000001	0.0017140	3.9079178	0.0019540
	Robertson	0.0039506	97.5712788	0.0055755	108.3038978	0.0002693	0.4754506	0.0246170	342.2318278	548.5824550	0.2742912
	Titus	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Upton	0.0000025	0.0628179	0.0000156	0.3030835	0.0026494	4.6775003	0.0000002	0.0022130	5.0456148	0.0025228
	Ward	0.0001995	4.9277247	0.0012239	23.7752727	0.2078335	366.9247636	0.0000125	0.1736002	395.8013612	0.1979007
	Webb	0.0042017	103.7742332	0.0002834	5.5045544	0.0000137	0.0241648	0.0335565	466.5125059	575.8154584	0.2879077
	Wharton	0.0021095	52.1007566	0.0001423	2.7636094	0.0000069	0.0121322	0.0168474	234.2166622	289.0931604	0.1445466
	Wichita	0.0000121	0.2991957	0.0000743	1.4435585	0.0126190	22.2784979	0.0000008	0.0105405	24.0317925	0.0120159
	Wilbarger	0.0179710	443.8479796	0.1102430	2141.4765315	0.0053249	9.4010128	0.0011247	15.6364497	2610.3619737	1.3051810
	Wise	0.0010202	25.1964202	0.0062583	121.5676200	0.0003023	0.5336779	0.0000638	0.8876520	148.1853702	0.0740927
	Young	0.0071054	175.4892037	0.0435880	846.6998351	0.0021054	3.7169849	0.0004447	6.1823603	1032.0883840	0.5160442
	Total	**0.4414501**	**10902.93493**	**0.4812863**	**9349.012953**	**0.5345786**	**943.7847773**	**0.6829349**	**9494.351446**	**30690.0841035**	**15.3450421**

Energy Savings by PCA (MWh)		24,698.00		19,425.06		1,765.47		13,902.28	

4.1.4 2012 Results for New Multi-family Residential Construction

This section provides potential electricity and natural gas reductions and associated emissions reductions from the implementation of the 2006 IECC for new multi-family residences in all the counties in ERCOT region as well as the 41 non-attainment and affected counties. To calculate the NOx emissions reductions from the implementation of the 2006 IECC for multi-family residences, new construction activity was determined by county. Energy savings attributable to the 2006 IECC was then calculated using the Laboratory's code-traceable, DOE-2.1e simulation, which was developed for the TERP. Next, these estimates were applied to the NAHB Builder's survey data to determine the appropriate number of housing types. In addition, the NOx reduction potential from the electricity reductions in each county was calculated using the US EPA's 2010 eGRID database[23].

In Table 8, the 2012 and the 2006 IECC code-compliant building characteristics for multi-family are shown for each county. The 2006 IECC code-compliant characteristics are the minimum building code characteristics required by the 2006 IECC for each county for multi-family residences (i.e., Type A.2). In Table 8, the rows are sorted first by the US EPA's non-attainment and affected designation, and other ERCOT counties, alphabetically. The fifth, sixth, seventh, and eighth columns in Table 8 show the NAHB Builder's survey average glazing U-value, Solar Heat Gain Coefficient (SHGC), roof insulation and wall insulation, respectively. In columns ninth through twelfth, the corresponding values from the 2006 IECC code-compliant house are listed for each county (i.e., glazing U-value, SHGC, roof and wall insulation R-value).

The 2006 IECC SHGC is 0.4 for all non-attainment and affected counties as required by the 2006 IECC. All houses were assumed to have air conditioner efficiency equal to a SEER 13, and furnace efficiency (AFUE) of 0.80. The values shown in Table 8 represent the only changes that were made to the simulation to obtain the savings calculations. All other variables in the simulation remained the same for the 2012 and the 2006 IECC code-compliant simulation. In cases where the 2012 values were more efficient than the 2006 IECC code-compliant simulation, the 2012 values were used in both simulations, since this indicates that the prevailing practice is already above code.

In Table 9, the code-traceable simulation results for multi-family are shown for each county. In a similar fashion as Table 8, the tables are first divided into US EPA's non-attainment and affected classifications, followed by an alphabetical listing of other ERCOT counties. In the third column, the 2006 IECC climate zone is listed followed by the number of projected new housing units[24] in the fourth column. In the fifth column, the total simulated energy use is listed if all new construction had been built to pre-code specifications, and, in the sixth column, the total county-wide energy use for code-compliant construction is shown. 144 simulations were run for each county, which were then distributed according to the NAHB Builder's survey data to account for 1, 2 or 3 story, and 3 fuel options (i.e., central air conditioning with electric resistance heating, heat pump heating, or a natural gas-fired furnace).

In the seventh column of Table 9, the total annual electricity savings are shown for each county, respectively. In similar fashion as the 2011 report, a 7% transmission and distribution loss is used in the 2012 report, which represents a fixed 1.07 multiplier for the electricity use. In the eighth and ninth columns, the total annual pre-code and code-compliant natural gas use is shown for those residences that had natural gas-fired furnaces and domestic water heaters. Finally, in column in tenth, the total annual natural gas savings are shown for each county.

In Table 10, the annual electricity savings from Table 9 is assigned to CM Zones provider(s) in a similar fashion as the single-family residential assignments. The total electricity savings for each CM Zone, as shown in Table 10, are then entered into the bottom row of Table 11, the 2010 US EPA's eGRID database for Texas. eGRID then proportions each MWh of electricity savings according to the 2008 measured data from the power plants assigned to that CM Zones. For each county in which there is a power plant, the lbs-NOx/MWh are calculated and displayed as NOx reductions (lbs) in the column adjacent to the CM Zone column. In a similar fashion as the single-family residences, adding across the rows then totals the NOx reductions in each county from multiple CM Zones that have power plants in that county. Counties that do not show NOx reductions represent counties that do not have power plants in eGRID's database.

[23] This analysis assumes transmission and distribution losses of 7%. Counties were assigned to utility service districts as indicated in a fashion similar to the 2011 report.
[24] The number of projected new housing units uses the published values for the new housing units in 2012. A vacancy rate of 0% was assumed for 2010 calculations, based on information suggested by the Real Estate Center at Texas A&M University.

Table 8: 2012 and the 2006 IECC Code-compliant Building Characteristics used in the DOE-2 Simulations for Multi-family Residential Buildings

			Division	2012 Average				2006 IECC			
	COUNTY	Climate Zone	(East or West)	Glazing U-value (Btu/hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)	Glazing U-value (Btu/hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)
	Brazoria	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Chambers	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Collin	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Dallas	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Denton	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	El Paso	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Fort Bend	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
Non-attainment	Galveston	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Hardin	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Harris	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Jefferson	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Liberty	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Montgomery	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Orange	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Tarrant	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Waller	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Bastrop	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Bexar	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Caldwell	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Comal	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Ellis	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Gregg	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Guadalupe	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Harrison	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Hays	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Henderson	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Hood	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Hunt	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
Affected	Johnson	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Kaufman	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Nueces	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Parker	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Rockwall	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Rusk	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	San Patricio	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Smith	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Travis	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Upshur	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	Victoria	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Williamson	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	Wilson	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	ANDERSON	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	ANDREWS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	ANGELINA	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	ARANSAS	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	ARCHER	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	ATASCOSA	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	AUSTIN	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	BANDERA	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	BASTROP	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	BAYLOR	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	BEE	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	BELL	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	BEXAR	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	BLANCO	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	BORDEN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	BOSQUE	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	BRAZORIA	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	BRAZOS	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	BREWSTER	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	BRISCOE	4	West Texas	0.44	0.53	30.87	15.95	0.65	NR	38	13.00
	BROOKS	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	BROWN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	BURLESON	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	BURNET	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	CALDWELL	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	CALHOUN	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	CALLAHAN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	CAMERON	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	CHAMBERS	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	CHEROKEE	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	CHILDRESS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	CLAY	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	COKE	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
ERCOT	COLEMAN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	COLLIN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	COLORADO	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	COMAL	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	COMANCHE	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	CONCHO	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	COOKE	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	CORYELL	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	COTTLE	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	CRANE	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	CROCKETT	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	CROSBY	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	CULBERSON	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	DALLAS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	DAWSON	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	DE WITT	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	DELTA	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	DENTON	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	DICKENS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	DIMMIT	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	DUVAL	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	EASTLAND	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	ECTOR	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	EDWARDS	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	ELLIS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	ERATH	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	FALLS	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	FANNIN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	FAYETTE	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	FISHER	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	FOARD	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	FORT BEND	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	FRANKLIN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	FREESTONE	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00

Table 13: 2012 and the 2006 IECC Code-compliant Building Characteristics used in the DOE-2 Simulations for Multi-family Residential Buildings (Continued)

			Division	2012 Average				2006 IECC			
	COUNTY	Climate Zone	(East or West)	Glazing U-value (Btu/hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)	Glazing U-value (Btu/hr-ft2-F)	SHGC	Roof Insulation (hr-ft2-F/Btu)	Wall Insulation (hr-ft2-F/Btu)
	FRIO	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	GALVESTON	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	GILLESPIE	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	GLASSCOCK	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	GOLIAD	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	GONZALES	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	GRAYSON	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	GRIMES	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	GUADALUPE	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	HALL	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	HAMILTON	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	HARDEMAN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	HARRIS	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	HASKELL	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	HAYS	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	HENDERSON	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	HIDALGO	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	HILL	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	HOOD	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	HOPKINS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	HOUSTON	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	HOWARD	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	HUDSPETH	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	HUNT	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	IRION	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	JACK	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	JACKSON	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	JEFF DAVIS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	JIM HOGG	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	JIM WELLS	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	JOHNSON	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	JONES	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	KARNES	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	KAUFMAN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	KENDALL	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	KENEDY	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	KENT	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	KERR	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	KIMBLE	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	KING	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	KINNEY	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	KLEBERG	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	KNOX	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	LA SALLE	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	LAMAR	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	LAMPASAS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	LAVACA	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	LEE	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	LEON	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	LIMESTONE	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	LIVE OAK	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	LLANO	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	LOVING	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	MADISON	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	MARTIN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	MASON	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	MATAGORDA	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	MAVERICK	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	MCCULLOCH	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	MCLENNAN	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	MCMULLEN	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	MEDINA	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	MENARD	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
ERCOT	MIDLAND	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	MILAM	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	MILLS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	MITCHELL	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	MONTAGUE	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	MONTGOMERY	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	MOTLEY	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	NACOGDOCHES	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	NAVARRO	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	NOLAN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	NUECES	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	PALO PINTO	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	PARKER	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	PECOS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	PRESIDIO	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	RAINS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	REAGAN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	REAL	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	RED RIVER	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	REEVES	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	REFUGIO	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	ROBERTSON	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	ROCKWALL	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	RUNNELS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	RUSK	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	SAN PATRICIO	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	SAN SABA	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	SCHLEICHER	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	SCURRY	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	SHACKELFORD	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	SMITH	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	SOMERVELL	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	STARR	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	STEPHENS	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	STERLING	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	STONEWALL	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	SUTTON	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	TARRANT	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	TAYLOR	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	TERRELL	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	THROCKMORTON	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	TITUS	3	East Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	TOM GREEN	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	TRAVIS	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	UPTON	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	UVALDE	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	VAL VERDE	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	VAN ZANDT	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	VICTORIA	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	WALLER	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	WARD	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	WASHINGTON	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	WEBB	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	WHARTON	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	WICHITA	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	WILBARGER	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	WILLACY	2	East Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	WILLIAMSON	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	WILSON	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	WINKLER	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	WISE	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	YOUNG	3	West Texas	0.44	0.53	30.87	15.95	0.65	0.40	30	13.00
	ZAPATA	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00
	ZAVALA	2	West Texas	0.44	0.53	30.87	15.95	0.75	0.40	30	13.00

Table 9: 2012 Annual Electricity and Natural Gas Savings from Implementation of the 2006 IECC for Multi-family Residences Buildings

2012 Summary TRY 2008									
	County	Climate Zone	No. of Projected Units (2012)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Total Annual NG Savings (Therm/yr)
Nonattain-ment County	BRAZORIA	3	438	19,725	19,042	730.79	95,025	94,895	130.62
	CHAMBERS	4	0	0	0	0.00	0	0	0.00
	COLLIN	6	3,504	174,683	166,192	9,085.60	1,026,361	952,811	73,549.66
	DALLAS	5	8,394	418,015	397,738	21,697.04	2,464,367	2,286,378	177,988.77
	DENTON	6	1,940	96,714	92,013	5,030.27	568,248	527,527	40,720.99
	EL PASO	6	1,179	53,042	50,692	2,514.65	362,191	330,702	31,488.99
	FORT BEND	4	208	9,369	9,044	347.72	45,126	45,053	73.37
	GALVESTON	3	183	8,241	7,956	305.33	39,702	39,648	54.57
	HARDIN	4	80	3,549	3,429	128.33	17,652	17,667	-15.42
	HARRIS	4	12,604	567,713	548,021	21,070.45	2,734,478	2,730,032	4,445.87
	JEFFERSON	4	456	20,234	19,549	733.15	100,616	100,524	92.05
	LIBERTY	4	4	180	174	6.72	867	866	0.86
	MONTGOMERY	4	1,162	52,339	50,524	1,942.55	252,100	251,690	409.88
	ORANGE	4	0	0	0	0.00	0	0	0.00
	TARRANT	5	2,732	136,052	129,452	7,061.75	802,079	744,149	57,930.11
	WALLER	4	63	2,838	2,739	105.32	13,668	13,646	22.22
Affected County	BASTROP	4	0	0	0	0.00	0	0	0.00
	BEXAR	4	2,822	130,377	125,204	5,535.85	641,869	608,867	33,001.99
	CALDWELL	4	4	192	183	9.62	0	0	0.00
	COMAL	4	26	1,201	1,154	51.00	5,914	5,610	304.06
	ELLIS	5	92	4,582	4,359	237.80	27,010	25,059	1,950.79
	GREGG	6	426	20,988	20,236	804.30	115,556	115,561	-5.01
	GUADALUPE	4	0	0	0	0.00	0	0	0.00
	HARRISON	6	6	295	284	11.13	1,634	1,634	0.01
	HAYS	5	1,901	91,239	86,965	4,573.59	485,321	451,551	33,770.04
	HENDERSON	5	16	786	758	29.59	4,363	4,364	-0.52
	HOOD	5	16	797	758	41.36	4,697	4,358	339.27
	HUNT	6	0	0	0	0.00	0	0	0.00
	JOHNSON	5	376	18,725	17,816	971.90	110,389	102,416	7,972.81
	KAUFMAN	6	0	0	0	0.00	0	0	0.00
	NUECES	3	223	10,322	9,921	429.62	44,290	44,247	43.08
	PARKER	6	96	4,786	4,553	248.92	28,119	26,104	2,015.06
	ROCKWALL	6	118	5,883	5,597	305.96	34,564	32,087	2,476.84
	RUSK	5	0	0	0	0.00	0	0	0.00
	SAN PATRICIO	3	0	0	0	0.00	0	0	0.00
	SMITH	5	125	6,140	5,924	231.16	34,089	34,093	-4.08
	TRAVIS	5	8,059	386,796	368,675	19,389.03	2,057,446	1,914,283	143,162.94
	UPSHUR	6	24	1,196	1,138	62.20	7,049	6,535	514.04
	VICTORIA	3	32	1,459	1,406	56.03	6,804	6,795	8.60
	WILLIAMSON	5	1,370	65,754	62,673	3,296.06	349,758	325,421	24,337.17
	WILSON	4	34	1,571	1,508	66.70	7,733	7,336	397.61
ERCOT	ANDERSON	5	0	0	0	0.00	0	0	**0**
	ANDREWS	6	0	0	0	0.00	0	0	**0**
	ANGELINA	5	2	90	87	3.28	480	479	**1**
	ARANSAS	3	0	0	0	0.00	0	0	**0**
	ARCHER	7	0	0	0	0.00	0	0	**0**
	ATASCOSA	3	8	370	355	15.62	1,845	1,744	**101**
	AUSTIN	4	0	0	0	0.00	0	0	**0**
	BANDERA	5	0	0	0	0.00	0	0	**0**
	BAYLOR	7	0	0	0	0.00	0	0	**0**
	BEE	3	0	0	0	0.00	0	0	**0**
	BELL	5	484	23,068	21,978	1,166.35	143,588	132,322	**11,266**
	BLANCO	5	26	1,248	1,189	62.55	6,638	6,176	**462**
	BORDEN	7	0	0	0	0.00	0	0	**0**
	BOSQUE	5	0	0	0	0.00	0	0	**0**
	BRAZOS	4	1,236	55,672	53,741	2,066.26	268,154	267,718	**436**
	BREWSTER	5	6	289	274	15.68	1,784	1,643	**142**
	BRISCOE	8	0	0	0	0.00	0	0	**0**
	BROOKS	2	0	0	0	0.00	0	0	**0**
	BROWN	5	0	0	0	0.00	0	0	**0**
	BURLESON	4	0	0	0	0.00	0	0	**0**
	BURNET	5	0	0	0	0.00	0	0	**0**
	CALHOUN	3	8	365	352	14.01	1,701	1,699	**2**
	CALLAHAN	6	8	387	367	21.47	2,605	2,392	**212**
	CAMERON	2	142	6,699	6,431	287.13	26,106	26,021	**85**
	CHEROKEE	5	2	90	87	3.28	480	479	**1**
	CHILDRESS	7	0	0	0	0.00	0	0	**0**
	CLAY	7	0	0	0	0.00	0	0	**0**
	COKE	6	0	0	0	0.00	0	0	**0**
	COLEMAN	5	0	0	0	0.00	0	0	**0**
	COLORADO	4	0	0	0	0.00	0	0	**0**
	COMANCHE	5	0	0	0	0.00	0	0	**0**
	CONCHO	5	0	0	0	0.00	0	0	**0**
	COOKE	6	0	0	0	0.00	0	0	**0**
	CORYELL	5	104	4,957	4,722	250.62	30,854	28,433	**2,421**
	COTTLE	7	0	0	0	0.00	0	0	**0**
	CRANE	5	0	0	0	0.00	0	0	**0**
	CROCKETT	5	0	0	0	0.00	0	0	**0**
	CROSBY	7	0	0	0	0.00	0	0	**0**
	CULBERSON	6	0	0	0	0.00	0	0	**0**
	DAWSON	7	0	0	0	0.00	0	0	**0**
	DE WITT	3	0	0	0	0.00	0	0	**0**
	DELTA	6	0	0	0	0.00	0	0	**0**
	DICKENS	7	0	0	0	0.00	0	0	**0**
	DIMMIT	3	0	0	0	0.00	0	0	**0**
	DUVAL	3	0	0	0	0.00	0	0	**0**
	EASTLAND	6	0	0	0	0.00	0	0	**0**
	ECTOR	6	428	20,721	19,643	1,152.98	137,424	125,869	**11,555**
	EDWARDS	5	0	0	0	0.00	0	0	**0**
	ERATH	6	8	387	367	21.47	2,605	2,392	**212**
	FALLS	5	0	0	0	0.00	0	0	**0**
	FANNIN	6	0	0	0	0.00	0	0	**0**
	FAYETTE	4	0	0	0	0.00	0	0	**0**
	FISHER	6	0	0	0	0.00	0	0	**0**
	FOARD	7	0	0	0	0.00	0	0	**0**
	FRANKLIN	6	0	0	0	0.00	0	0	**0**
	FREESTONE	5	0	0	0	0.00	0	0	**0**
	FRIO	3	0	0	0	0.00	0	0	**0**

Table 14: 2012 Annual Electricity and Natural Gas Savings from Implementation of the 2006 IECC for Multi-family Residences Buildings (Continued)

2012 Summary TRY 2008									
	County	Climate Zone	No. of Projected Units (2012)	Precode Total Annual Elec. Use (MWh/yr)	Code-compliant Total Annual Elec. Use (MWh/yr)	Total Annual Elec. Savings (MWh/yr) w/ 7% of T&D Loss	Precode Total NG Use (Therm/yr)	Code-compliant Total NG Use (Therm/yr)	Total Annual NG Savings (Therm/yr)
	GILLESPIE	5	0	0	0	0.00	0	0	0
	GLASSCOCK	6	0	0	0	0.00	0	0	0
	GOLIAD	3	0	0	0	0.00	0	0	0
	GONZALES	4	0	0	0	0.00	0	0	0
	GRAYSON	6	6	299	284	15.53	1,760	1,632	127
	GRIMES	4	0	0	0	0.00	0	0	0
	HALL	8	0	0	0	0.00	0	0	0
	HAMILTON	5	0	0	0	0.00	0	0	0
	HARDEMAN	7	0	0	0	0.00	0	0	0
	HASKELL	6	0	0	0	0.00	0	0	0
	HIDALGO	2	663	31,279	30,026	1,340.59	121,891	121,493	398
	HILL	5	0	0	0	0.00	0	0	0
	HOPKINS	6	160	7,976	7,589	414.87	46,866	43,507	3,358
	HOUSTON	5	0	0	0	0.00	0	0	0
	HOWARD	6	0	0	0	0.00	0	0	0
	HUDSPETH	6	0	0	0	0.00	0	0	0
	IRION	5	0	0	0	0.00	0	0	0
	JACK	6	0	0	0	0.00	0	0	0
	JACKSON	3	0	0	0	0.00	0	0	0
	JEFF DAVIS	6	0	0	0	0.00	0	0	0
	JIM HOGG	2	0	0	0	0.00	0	0	0
	JIM WELLS	3	0	0	0	0.00	0	0	0
	JONES	6	0	0	0	0.00	0	0	0
	KARNES	3	0	0	0	0.00	0	0	0
	KENDALL	5	0	0	0	0.00	0	0	0
	KENEDY	2	0	0	0	0.00	0	0	0
	KENT	7	0	0	0	0.00	0	0	0
	KERR	5	0	0	0	0.00	0	0	0
	KIMBLE	5	0	0	0	0.00	0	0	0
	KING	7	0	0	0	0.00	0	0	0
	KINNEY	4	0	0	0	0.00	0	0	0
	KLEBERG	2	32	1,480	1,423	61.64	6,426	6,417	9
	KNOX	7	0	0	0	0.00	0	0	0
	LA SALLE	3	102	4,721	4,538	196.51	20,258	20,238	20
	LAMAR	6	24	1,196	1,138	62.23	7,030	6,526	504
	LAMPASAS	5	0	0	0	0.00	0	0	0
	LAVACA	4	0	0	0	0.00	0	0	0
	LEE	4	16	768	732	38.47	4,086	3,801	285
	LEON	5	0	0	0	0.00	0	0	0
	LIMESTONE	5	0	0	0	0.00	0	0	0
	LIVE OAK	3	0	0	0	0.00	0	0	0
	LLANO	5	10	480	457	24.06	2,553	2,375	178
	LOVING	6	0	0	0	0.00	0	0	0
	MADISON	4	0	0	0	0.00	0	0	0
	MARTIN	6	0	0	0	0.00	0	0	0
	MASON	5	0	0	0	0.00	0	0	0
	MATAGORDA	3	0	0	0	0.00	0	0	0
	MAVERICK	3	4	185	178	7.71	794	794	1
	MCCULLOCH	5	0	0	0	0.00	0	0	0
	MCLENNAN	5	189	9,008	8,582	455.45	56,070	51,671	4,399
	MCMULLEN	3	0	0	0	0.00	0	0	0
ERCOT	MEDINA	4	12	554	532	23.54	2,729	2,589	140
	MENARD	5	0	0	0	0.00	0	0	0
	MIDLAND	6	410	19,849	18,817	1,104.49	131,644	120,576	11,069
	MILAM	4	0	0	0	0.00	0	0	0
	MILLS	5	0	0	0	0.00	0	0	0
	MITCHELL	6	0	0	0	0.00	0	0	0
	MONTAGUE	6	0	0	0	0.00	0	0	0
	MOTLEY	7	0	0	0	0.00	0	0	0
	NACOGDOCHE	5	206	9,272	8,956	337.46	49,481	49,380	101
	NAVARRO	5	42	2,002	1,907	101.21	12,460	11,482	978
	NOLAN	6	0	0	0	0.00	0	0	0
	PALO PINTO	6	0	0	0	0.00	0	0	0
	PECOS	5	0	0	0	0.00	0	0	0
	PRESIDIO	5	2	96	91	5.23	595	548	47
	RAINS	6	0	0	0	0.00	0	0	0
	REAGAN	5	0	0	0	0.00	0	0	0
	REAL	5	0	0	0	0.00	0	0	0
	RED RIVER	6	0	0	0	0.00	0	0	0
	REEVES	6	0	0	0	0.00	0	0	0
	REFUGIO	3	0	0	0	0.00	0	0	0
	ROBERTSON	4	0	0	0	0.00	0	0	0
	RUNNELS	5	0	0	0	0.00	0	0	0
	SAN SABA	5	0	0	0	0.00	0	0	0
	SCHLEICHER	5	0	0	0	0.00	0	0	0
	SCURRY	7	40	1,992	1,882	118.26	16,768	15,181	1,587
	SHACKELFORI	6	0	0	0	0.00	0	0	0
	SOMERVELL	5	0	0	0	0.00	0	0	0
	STARR	2	0	0	0	0.00	0	0	0
	STEPHENS	6	0	0	0	0.00	0	0	0
	STERLING	6	0	0	0	0.00	0	0	0
	STONEWALL	7	0	0	0	0.00	0	0	0
	SUTTON	5	0	0	0	0.00	0	0	0
	TAYLOR	6	206	9,969	9,452	552.90	67,068	61,599	5,469
	TERRELL	5	0	0	0	0.00	0	0	0
	THROCKMORT	6	0	0	0	0.00	0	0	0
	TITUS	6	2	100	95	5.19	586	544	42
	TOM GREEN	5	176	8,471	8,042	459.81	52,344	48,192	4,152
	UPTON	5	0	0	0	0.00	0	0	0
	UVALDE	4	32	1,478	1,420	62.77	7,278	6,904	374
	VAL VERDE	4	48	2,218	2,130	94.16	10,918	10,356	561
	VAN ZANDT	6	0	0	0	0.00	0	0	0
	WARD	6	0	0	0	0.00	0	0	0
	WASHINGTON	4	0	0	0	0.00	0	0	0
	WEBB	3	756	34,993	33,632	1,456.47	150,148	150,002	146
	WHARTON	3	0	0	0	0.00	0	0	0
	WICHITA	7	146	7,542	7,121	450.85	54,439	49,636	4,803
	WILBARGER	7	0	0	0	0.00	0	0	0
	WILLACY	2	0	0	0	0.00	0	0	0
	WINKLER	6	0	0	0	0.00	0	0	0
	WISE	6	4	199	190	10.37	1,172	1,088	84
	YOUNG	6	0	0	0	0.00	0	0	0
	ZAPATA	2	0	0	0	0.00	0	0	0
	ZAVALA	3	0	0	0	0.00	0	0	0
	TOTAL		54,463			119,592			702,905

Table 10: 2012 Totalized Annual Electricity Savings from the 2006 IECC by CM Zones for Multi-family Residences

CM Zones	Total Electricity Savings by CM Zones (MWh) 2011-TRY 2008
H	32,178.93
N	38,553.34
W	3,480.31
S	30,087.62
Total	104,300.20

Table 11: 2012 Annual NOx Reductions from the 2006 IECC by CM Zones for Multi-family Residences by County using 2010 eGRID

Area	County	H	NOx Reductions (lbs)	N	NOx Reductions (lbs)	W	NOx Reductions (lbs/year)	S	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.0562032	1808.5589327	0.0000071	0.2749066	0.0000003	0.0011987	0.0005265	15.8423982	1824.6774362	0.9123387
	Chambers	0.0204500	658.0593577	0.0000026	0.1000271	0.0000001	0.0004361	0.0001916	5.7643896	663.9242105	0.3319621
	Fort Bend	0.0313463	1008.6912190	0.0000040	0.1533242	0.0000002	0.0006685	0.0002937	8.8358127	1017.6810245	0.5088405
	Galveston	0.0226620	729.2378835	0.0000029	0.1108464	0.0000001	0.0004833	0.0002123	6.3878908	735.7371041	0.3678686
	Harris	0.1486911	4784.7216836	0.0000189	0.7272926	0.0000009	0.0031712	0.0013930	41.9126326	4827.3647800	2.4136824
Dallas/ Fort Worth Area	Collin	0.0012932	41.6127680	0.0079329	305.8409120	0.0003832	1.3335618	0.0000809	2.4351320	351.2223738	0.1756112
	Dallas	0.0024826	79.8876896	0.0152295	587.1496902	0.0007356	2.5601558	0.0001554	4.6749369	674.2724726	0.3371362
	Denton	0.0001267	4.0758976	0.0007770	29.9565807	0.0000375	0.1306200	0.0000079	0.2385169	34.4016153	0.0172008
	Tarrant	0.0004742	15.2586925	0.0029089	112.1466477	0.0001405	0.4889944	0.0000297	0.8929214	128.7872560	0.0643936
	Ellis	0.0029920	96.2791168	0.0183544	707.6215853	0.0008865	3.0854508	0.0001873	5.6341446	812.6202976	0.4063101
	Johnson	0.0007256	23.3489998	0.0044512	171.6078916	0.0002150	0.7482639	0.0000454	1.3663570	197.0715123	0.0985358
	Kaufman	0.0059718	192.1677093	0.0366343	1412.3729390	0.0017695	6.1583866	0.0003738	11.2454362	1621.9444711	0.8109722
	Parker	0.0000012	0.0395647	0.0000075	0.2907879	0.0000004	0.0012679	0.0000001	0.0023153	0.3339358	0.0001670
	Henderson	0.0006908	22.2284420	0.0042376	163.3721400	0.0002047	0.7123535	0.0000432	1.3007832	187.6137187	0.0938069
	Hood	0.0050771	163.3755180	0.0311454	1200.7592812	0.0015044	5.2356850	0.0003178	9.5605499	1378.9310341	0.6894655
	Hunt	0.0088463	284.6656467	0.0047066	181.4565867	0.0002273	0.7912073	0.0652823	1964.1889150	2431.1023556	1.2155512
San Antonio Area	Bexar	0.0138906	446.9848476	0.0009368	36.1173055	0.0000452	0.1574827	0.1109355	3337.7864495	3821.0460853	1.9105230
	Guadalupe	0.0032029	103.0655560	0.0002160	8.3279113	0.0000104	0.0363123	0.0255795	769.6252300	881.0550096	0.4405275
Austin Area	Bastrop	0.0033782	108.7076426	0.0002278	8.7838037	0.0000110	0.0383001	0.0269798	811.7565918	929.2863382	0.4646432
	Hays	0.0008331	26.8091976	0.0000562	2.1662389	0.0000027	0.0094455	0.0066537	200.1933106	229.1781926	0.1145891
	Travis	0.0051785	166.6397371	0.0003493	13.4648374	0.0000169	0.0587109	0.0413577	1244.3550590	1424.5183444	0.7122592
	Rusk	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Corpus Christi Area	Nueces	0.0128578	413.7495943	0.0008672	33.4318279	0.0000419	0.1457732	0.1026870	3089.6076156	3536.9348109	1.7684674
	San Patricio	0.0015100	48.5886964	0.0001018	3.9260677	0.0000049	0.0171189	0.0120591	362.8281657	415.3600487	0.2076800
Victoria Area	Victoria	0.0021192	68.1921717	0.0001429	5.5100693	0.0000069	0.0240256	0.0169244	509.2139207	582.9401874	0.2914701
Other ERCOT counties	Andrews	0.0000037	0.1204858	0.0000230	0.8855332	0.0039003	13.5741490	0.0000002	0.0070507	14.5872188	0.0072936
	Bosque	0.0022204	71.4508780	0.0136212	525.1417468	0.0006579	2.2897818	0.0001390	4.1812243	603.0636308	0.3015318
	Brazos	0.0024089	77.5151027	0.0112305	432.9739638	0.0005425	1.8879015	0.0047829	143.9063425	656.2833106	0.3281417
	Calhoun	0.0009466	30.4600250	0.0000638	2.4612334	0.0000031	0.0107317	0.0075598	227.4552687	260.3872588	0.1301936
	Cameron	0.0063536	204.4530519	0.0004285	16.5202319	0.0000207	0.0720334	0.0507425	1526.7198200	1747.7651372	0.8738686
	Cherokee	0.0027392	88.1430934	0.0168033	647.8243424	0.0008116	2.8247162	0.0001714	5.1580338	743.9501859	0.3719751
	Coke	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Ector	0.0019215	61.8320898	0.0006604	25.4588925	0.0911346	317.1763993	0.0146527	440.8643939	845.3317754	0.4226659
	Fannin	0.0000041	0.1304829	0.0000249	0.9590086	0.0000012	0.0041816	0.0000003	0.0076357	1.1013087	0.0005507
	Fayette	0.0051867	166.9025429	0.0103217	397.9351506	0.0004986	1.7351214	0.0283993	854.4675396	1421.0403544	0.7105202
	Freestone	0.0047643	153.3113386	0.0292268	1126.7906904	0.0014117	4.9131589	0.0002982	8.9716055	1293.9867934	0.6469934
	Frio	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Grimes	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Hidalgo	0.0053716	172.8515680	0.0003623	13.9667663	0.0000175	0.0608995	0.0428994	1290.7408934	1477.6201272	0.7388101
	Howard	0.0002411	7.7589128	0.0007641	29.4574627	0.1283942	446.8509310	0.0009490	28.5528828	512.6201894	0.2563101
	Jack	0.0030783	99.0568391	0.0188839	728.0369808	0.0009121	3.1744683	0.0001927	5.7966938	836.0649820	0.4180325
	Lamar	0.0040001	128.7202941	0.0245388	946.0541560	0.0011853	4.1250912	0.0002504	7.5325655	1086.4321067	0.5432161
	Limestone	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Llano	0.0040314	129.7276764	0.0002719	10.4822661	0.0000131	0.0457059	0.0321966	968.7202661	1108.9759146	0.5544880
	McLennan	0.0056576	182.0562479	0.0347066	1338.0568405	0.0016764	5.8343452	0.0003541	10.6537250	1536.6011587	0.7683006
	Milam	0.0012686	40.8223950	0.0000856	3.2985344	0.0000041	0.0143826	0.0101316	304.8345768	348.9698889	0.1744849
	Mitchell	0.0000311	1.0016906	0.0001910	7.3621148	0.0324260	112.8522780	0.0000019	0.0586178	121.2747012	0.0606374
	Nolan	0.0000293	0.9414060	0.0001795	6.9190412	0.0304745	106.0604984	0.0000018	0.0550900	113.9760356	0.0569880
	Palo Pinto	0.0036129	116.2605063	0.0221635	854.4785886	0.0010705	3.7257932	0.0002261	6.8034329	981.2683210	0.4906342
	Pecos	0.0000020	0.0633905	0.0000121	0.4659007	0.0020520	7.1416923	0.0000001	0.0037095	7.6746931	0.0038373
	Robertson	0.0039506	127.1252546	0.0055755	214.9531573	0.0002693	0.9372628	0.0246170	740.6656847	1083.6813594	0.5418407
	Titus	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Upton	0.0000025	0.0818452	0.0000156	0.6015366	0.0026494	9.2208254	0.0000002	0.0047895	9.9089967	0.0049545
	Ward	0.0001995	6.4203141	0.0012239	47.1873131	0.2078335	723.3242007	0.0000125	0.3757095	777.3075374	0.3886538
	Webb	0.0042017	135.2070608	0.0002834	10.9250118	0.0000137	0.0476365	0.0335565	1009.6366749	1155.8163839	0.5779082
	Wharton	0.0021095	67.8818811	0.0001423	5.4849972	0.0000069	0.0239163	0.0168474	506.8968764	580.2876711	0.2901438
	Wichita	0.0000121	0.3898209	0.0000743	2.8650627	0.0126190	43.9179316	0.0000008	0.0228119	47.1956271	0.0235978
	Wilbarger	0.0179710	578.2878744	0.1102430	4250.2361489	0.0053249	18.5323553	0.0011247	33.8407501	4880.8971287	2.4404486
	Wise	0.0010202	32.8283217	0.0062583	241.2779620	0.0003023	1.0520472	0.0000638	1.9210761	277.0794070	0.1385397
	Young	0.0071054	228.6442278	0.0435880	1680.4640133	0.0021054	7.3273473	0.0004447	13.3800007	1929.8155891	0.9649078
	Total	0.4414501	14205.39318	0.4812863	18555.19415	0.5345786	1860.496858	0.6829349	20547.88522	55168.9694078	27.5844847

Energy Savings by PCA (MWh)		32,178.93		38,553.34		3,480.31		30,087.62	

1.1.1 2012 Results for New Residential Construction (Single-family and Multi-family), Using 2008 Base Year and 2010 eGRID

In Table 12, the combined NOx emissions reductions are listed from single-family electricity savings, multi-family electricity savings, and natural gas savings[25] (single-family and multi-family), which also show the 2012 annual electricity savings are shown for the combined single-family and multi-family savings.

Using the 2010 eGRID the total NOx reductions from electricity and natural gas savings from new construction in 2012 are 51.16 tons NOx/year, which represents 15.35 tons NOx/year (30.00 %) from single-family residential electricity savings, 27.58 tons NOx/year (53.91 %) from multi-family residential electricity savings, and 8.23 tons NOx/year (16.09 %) from natural gas savings from single-family and multi-family residential.

Figure 49 through Figure 52 show the electricity and NOx reductions tabulated in Table 19. Figure 49 shows the annual electricity savings by county as a stacked bar chart. Figure 50 shows the spatial distribution of the electricity savings by county across the state. Figure 51 shows the annual NOx reductions in a similar format as the electricity savings using a stacked bar chart with the ordering of the counties determined byTable 12, and Figure 52 shows the spatial distribution of the NOx savings by county across the state.

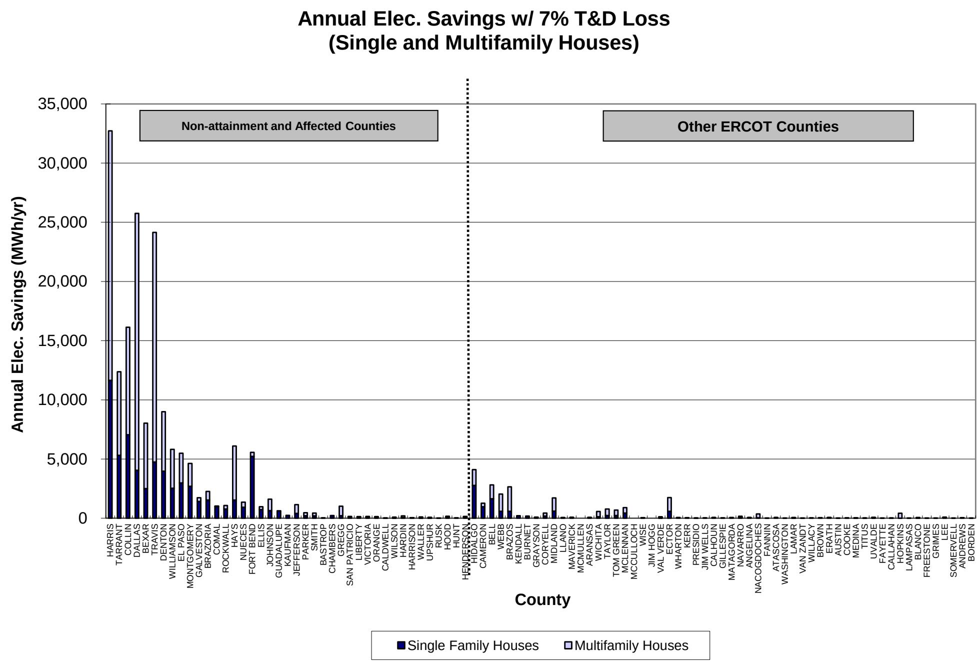
[25] 0.092 lb-NOx/MMBtu of emission rate was used for the calculation.

Table 12: 2012 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the 2006 IECC for Single-family and Multi-family Residences by County (Using 2008 Base year and 2010 eGRID)

	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Total Electricity Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Nox Reductions
County	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
HARRIS	11,645.82	1.85	21,070.45	2.41	32,716.27	4.26	163,936.53	0.75	5.01
TARRANT	5,316.17	0.03	7,061.75	0.06	12,377.92	0.10	136,799.72	0.63	0.73
COLLIN	7,047.38	0.09	9,085.60	0.18	16,132.99	0.27	177,194.80	0.82	1.08
DALLAS	4,045.56	0.18	21,697.04	0.34	25,742.60	0.52	238,007.86	1.09	1.61
BEXAR	2,498.22	0.95	5,535.85	1.91	8,034.07	2.86	64,160.47	0.30	3.16
TRAVIS	4,751.38	0.35	19,389.03	0.71	24,140.41	1.07	207,348.49	0.95	2.02
DENTON	3,971.33	0.01	5,030.27	0.02	9,001.60	0.03	99,126.88	0.46	0.48
WILLIAMSON	2,529.13		3,296.06		5,825.20	0.00	58,502.78	0.27	0.27
EL PASO	2,982.07		2,514.65		5,496.72	0.00	99,009.91	0.46	0.46
MONTGOMERY	2,692.55		1,942.55		4,635.09	0.00	37,284.56	0.17	0.17
GALVESTON	1,425.53	0.28	305.33	0.37	1,730.86	0.65	20,026.31	0.09	0.74
BRAZORIA	1,535.80	0.70	730.79	0.91	2,266.60	1.61	21,647.25	0.10	1.71
COMAL	982.59		51.00		1,033.60	0.00	12,559.22	0.06	0.06
ROCKWALL	774.75		305.96		1,080.72	0.00	13,871.06	0.06	0.06
HAYS	1,530.14	0.06	4,573.59	0.11	6,103.73	0.17	54,440.45	0.25	0.42
NUECES	924.27	0.88	429.62	1.77	1,353.89	2.65	9,377.26	0.04	2.69
FORT BEND	5,216.21	0.39	347.72	0.51	5,563.93	0.90	71,509.84	0.33	1.23
ELLIS	736.70	0.22	237.80	0.41	974.51	0.62	12,880.35	0.06	0.68
JOHNSON	639.32	0.05	971.90	0.10	1,611.21	0.15	17,457.56	0.08	0.23
GUADALUPE	634.77	0.22	0.00	0.44	634.77	0.66	7,917.05	0.04	0.70
KAUFMAN	251.36	0.43	0.00	0.81	251.36	1.24	3,696.79	0.02	1.26
JEFFERSON	411.81		733.15		1,144.96	0.00	5,980.73	0.03	0.03
PARKER	216.93	0.00	248.92	0.00	465.85	0.00	5,205.44	0.02	0.02
SMITH	205.78		231.16		436.94	0.00	3,460.87	0.02	0.02
BASTROP	40.65	0.23	0.00	0.46	40.65	0.70	1,319.89	0.01	0.70
CHAMBERS	223.01	0.25	0.00	0.33	223.01	0.59	3,093.48	0.01	0.60
GREGG	209.56		804.30		1,013.86	0.00	3,311.69	0.02	0.02
SAN PATRICIO	154.96	0.10	0.00	0.21	154.96	0.31	1,564.90	0.01	0.32
LIBERTY	132.43		6.72		139.15	0.00	1,848.02	0.01	0.01
VICTORIA	93.99	0.15	56.03	0.29	150.02	0.44	1,252.71	0.01	0.44
ORANGE	140.62		0.00		140.62	0.00	1,967.30	0.01	0.01
CALDWELL	6.44		9.62		16.06	0.00	87.68	0.00	0.00
WILSON	23.48		66.70		90.17	0.00	690.44	0.00	0.00
HARDIN	72.41		128.33		200.75	0.00	1,022.48	0.00	0.00
HARRISON	32.55		11.13		43.68	0.00	546.62	0.00	0.00
WALLER	6.40		105.32		111.72	0.00	109.91	0.00	0.00
UPSHUR	12.71		62.20		74.92	0.00	968.01	0.00	0.00
RUSK	3.21	0.00	0.00	0.00	3.21	0.00	58.10	0.00	0.00
HOOD	129.47	0.37	41.36	0.69	170.82	1.06	2,260.02	0.01	1.07
HUNT	29.80	0.61	0.00	1.22	29.80	1.82	439.32	0.00	1.83
HENDERSON	131.77	0.05	29.59	0.09	161.36	0.14	2,218.27	0.01	0.15
HIDALGO	2,770.53	0.37	1,340.59	0.74	4,111.13	1.11	22,377.07	0.10	1.21
CAMERON	978.29	0.44	287.13	0.87	1,265.42	1.31	7,846.20	0.04	1.35
BELL	1,644.32		1,166.35		2,810.67	0.00	43,891.24	0.20	0.20
WEBB	590.28	0.29	1,456.47	0.58	2,046.75	0.87	6,120.35	0.03	0.89
BRAZOS	581.89	0.17	2,066.26	0.33	2,648.15	0.50	8,405.03	0.04	0.54
KENDALL	216.51		0.00		216.51	0.00	2,918.14	0.01	0.01
BURNET	180.27		0.00		180.27	0.00	2,435.22	0.01	0.01
GRAYSON	81.36		15.53		96.89	0.00	1,326.97	0.01	0.01
CORYELL	183.49		250.62		434.11	0.00	6,061.51	0.03	0.03
MIDLAND	605.08		1,104.49		1,709.57	0.00	22,919.05	0.11	0.11
LLANO	39.70	0.28	24.06	0.55	63.76	0.83	713.97	0.00	0.83
MAVERICK	59.03		7.71		66.73	0.00	598.20	0.00	0.00
MCMULLEN	0.00		0.00		0.00	0.00	0.00	0.00	0.00
ARANSAS	81.12		0.00		81.12	0.00	819.27	0.00	0.00
WICHITA	126.76	0.01	450.85	0.02	577.61	0.04	7,642.03	0.04	0.07
TAYLOR	232.65		552.90		785.54	0.00	10,019.44	0.05	0.05
TOM GREEN	233.44		459.81		693.24	0.00	8,150.57	0.04	0.04
MCLENNAN	435.58	0.41	455.45	0.77	891.03	1.18	13,041.64	0.06	1.24
MCCULLOCH	0.00		0.00		0.00	0.00	0.00	0.00	0.00
WISE	33.29	0.07	10.37	0.14	43.66	0.21	573.49	0.00	0.22
JIM HOGG	0.00		0.00		0.00	0.00	0.00	0.00	0.00
VAL VERDE	25.22		94.16		119.38	0.00	875.85	0.00	0.00
ECTOR	586.90	0.21	1,152.98	0.42	1,739.88	0.64	23,048.89	0.11	0.74
WHARTON	64.35	0.14	0.00	0.29	64.35	0.43	851.83	0.00	0.44
KERR	49.36		0.00		49.36	0.00	666.79	0.00	0.00
PRESIDIO	3.06		5.23		8.28	0.00	99.56	0.00	0.00
JIM WELLS	31.90		0.00		31.90	0.00	322.19	0.00	0.00
CALHOUN	54.19	0.06	14.01	0.13	68.20	0.20	719.48	0.00	0.20
GILLESPIE	36.48		0.00		36.48	0.00	492.84	0.00	0.00
MATAGORDA	60.12		0.00		60.12	0.00	795.79	0.00	0.00
NAVARRO	65.92		101.21		167.13	0.00	2,285.46	0.01	0.01
ANGELINA	44.15		3.28		47.43	0.00	799.79	0.00	0.00
NACOGDOCHES	30.51		337.46		367.97	0.00	653.13	0.00	0.00
FANNIN	20.63	0.00	0.00	0.00	20.63	0.00	304.14	0.00	0.00
ATASCOSA	45.94		15.62		61.56	0.00	725.00	0.00	0.00
WASHINGTON	28.01		0.00		28.01	0.00	383.65	0.00	0.00
LAMAR	9.38	0.29	62.23	0.54	71.61	0.83	670.93	0.00	0.84
VAN ZANDT	5.74		0.00		5.74	0.00	84.40	0.00	0.00
WILLACY	35.77		0.00		35.77	0.00	283.75	0.00	0.00
BROWN	50.77		0.00		50.77	0.00	1,007.39	0.00	0.00
ERATH	45.73		21.47		67.21	0.00	1,106.93	0.01	0.01
AUSTIN	16.81		0.00		16.81	0.00	230.19	0.00	0.00
COOKE	42.40		0.00		42.40	0.00	625.18	0.00	0.00
MEDINA	12.17		23.54		35.71	0.00	292.17	0.00	0.00
TITUS	11.08	0.00	5.19	0.00	16.27	0.00	239.54	0.00	0.00
UVALDE	18.26		62.77		81.03	0.00	601.98	0.00	0.00
FAYETTE	3.20	0.36	0.00	0.71	3.20	1.07	43.85	0.00	1.07
CALLAHAN	6.96		21.47		28.43	0.00	348.51	0.00	0.00
HOPKINS	10.33		414.87		425.20	0.00	3,510.35	0.02	0.02
LAMPASAS	6.24		0.00		6.24	0.00	0.00	0.00	0.00
BLANCO	2.15		62.55		64.70	0.00	490.86	0.00	0.00
FREESTONE	8.91	0.35	0.00	0.65	8.91	0.99	176.74	0.00	0.99
GRIMES	20.01	0.00	0.00	0.00	20.01	0.00	274.04	0.00	0.00
LEE	50.44		38.47		88.92	0.00	971.90	0.00	0.00
SOMERVELL	6.87		0.00		6.87	0.00	101.99	0.00	0.00
ANDREWS	54.55	0.00	0.00	0.01	54.55	0.01	1,068.31	0.00	0.02
BORDEN	15.71		0.00		15.71	0.00	1,130.12	0.01	0.01

Table 17: 2012 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the 2006 IECC for Single-family and Multi-family Residences by County (Using 2008 Base year and 2010 eGRID) (Continued)

	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Total Electricity Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Nox Reductions
County	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
CHEROKEE	14.45	0.20	3.28	0.37	17.73	0.57	262.41	0.00	0.57
DIMMIT	3.94		0.00		3.94	0.00	39.83	0.00	0.00
FALLS	5.34		0.00		5.34	0.00	106.04	0.00	0.00
COLORADO	12.01		0.00		12.01	0.00	164.42	0.00	0.00
FRIO	24.55	0.00	0.00	0.00	24.55	0.00	333.30	0.00	0.00
MILAM	2.23	0.09	0.00	0.17	2.23	0.26	31.24	0.00	0.26
JACKSON	8.47		0.00		8.47	0.00	112.08	0.00	0.00
ANDERSON	4.82		0.00		4.82	0.00	87.14	0.00	0.00
HILL	1.78		0.00		1.78	0.00	35.35	0.00	0.00
CULBERSON	0.74		0.00		0.74	0.00	21.17	0.00	0.00
MASON	3.22		0.00		3.22	0.00	43.49	0.00	0.00
PECOS	6.12	0.00	0.00	0.00	6.12	0.01	104.77	0.00	0.01
RAINS	2.30		0.00		2.30	0.00	33.76	0.00	0.00
LAVACA	14.04		0.00		14.04	0.00	190.71	0.00	0.00
PALO PINTO	8.95	0.26	0.00	0.49	8.95	0.75	175.02	0.00	0.75
KIMBLE	0.00		0.00		0.00	0.00	0.00	0.00	0.00
MADISON	27.21		0.00		27.21	0.00	372.69	0.00	0.00
ARCHER	4.30		0.00		4.30	0.00	96.25	0.00	0.00
REFUGIO	8.47		0.00		8.47	0.00	112.08	0.00	0.00
LIMESTONE	0.89	0.00	0.00	0.00	0.89	0.00	17.67	0.00	0.00
CLAY	1.07		0.00		1.07	0.00	24.06	0.00	0.00
BEE	7.62		0.00		7.62	0.00	100.87	0.00	0.00
MARTIN	4.04		0.00		4.04	0.00	79.13	0.00	0.00
GONZALES	0.87		0.00		0.87	0.00	10.85	0.00	0.00
BURLESON	28.01		0.00		28.01	0.00	383.65	0.00	0.00
KARNES	47.87		0.00		47.87	0.00	649.69	0.00	0.00
KLEBERG	16.98		61.64		78.62	0.00	184.42	0.00	0.00
BREWSTER	7.14		15.68		22.81	0.00	263.77	0.00	0.00
WINKLER	2.02		0.00		2.02	0.00	39.57	0.00	0.00
FRANKLIN	0.00		0.00		0.00	0.00	0.00	0.00	0.00
YOUNG	28.83	0.52	0.00	0.96	28.83	1.48	563.95	0.00	1.48
HOUSTON	4.01		0.00		4.01	0.00	72.62	0.00	0.00
SCURRY	42.18		118.26		160.44	0.00	4,620.29	0.02	0.02
BOSQUE	1.78	0.16	0.00	0.30	1.78	0.46	35.35	0.00	0.46
COMANCHE	0.89		0.00		0.89	0.00	17.67	0.00	0.00
BRISCOE	8.83		0.00		8.83	0.00	270.66	0.00	0.00
CONCHO	1.02		0.00		1.02	0.00	17.46	0.00	0.00
ZAVALA	5.51		0.00		5.51	0.00	55.76	0.00	0.00
NOLAN	0.99	0.03	0.00	0.06	0.99	0.09	19.45	0.00	0.09
BROOKS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
ROBERTSON	17.61	0.27	0.00	0.54	17.61	0.82	241.15	0.00	0.82
LIVE OAK	11.85		0.00		11.85	0.00	119.67	0.00	0.00
HAMILTON	1.78		0.00		1.78	0.00	35.35	0.00	0.00
JONES	0.00		0.00		0.00	0.00	0.00	0.00	0.00
REAGAN	2.01		0.00		2.01	0.00	40.21	0.00	0.00
WARD	10.10	0.20	0.00	0.39	10.10	0.59	197.84	0.00	0.59
RED RIVER	5.97		0.00		5.97	0.00	106.38	0.00	0.00
HASKELL	1.99		0.00		1.99	0.00	38.89	0.00	0.00
HOWARD	15.15	0.13	0.00	0.26	15.15	0.39	296.75	0.00	0.39
SAN SABA	0.00		0.00		0.00	0.00	0.00	0.00	0.00
JACK	9.94	0.22	0.00	0.42	9.94	0.64	194.47	0.00	0.64
STEPHENS	2.98		0.00		2.98	0.00	58.34	0.00	0.00
RUNNELS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
REEVES	2.02		0.00		2.02	0.00	39.57	0.00	0.00
DE WITT	3.39		0.00		3.39	0.00	44.83	0.00	0.00
CHILDRESS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
CROSBY	6.62		0.00		6.62	0.00	475.84	0.00	0.00
DAWSON	9.98		0.00		9.98	0.00	700.90	0.00	0.00
MITCHELL	3.98	0.03	0.00	0.06	3.98	0.09	77.79	0.00	0.09
WILBARGER	0.00	1.31	0.00	2.44	0.00	3.75	0.00	0.00	3.75
COLEMAN	0.99		0.00		0.99	0.00	19.45	0.00	0.00
UPTON	7.02	0.00	0.00	0.00	7.02	0.01	140.74	0.00	0.01
COKE	1.02	0.00	0.00	0.00	1.02	0.00	17.70	0.00	0.00
CROCKETT	19.37		0.00		19.37	0.00	331.77	0.00	0.00
HARDEMAN	0.00		0.00		0.00	0.00	0.00	0.00	0.00
BANDERA	0.00		0.00		0.00	0.00	0.00	0.00	0.00
BAYLOR	0.00		0.00		0.00	0.00	0.00	0.00	0.00
COTTLE	0.00		0.00		0.00	0.00	0.00	0.00	0.00
CRANE	4.01		0.00		4.01	0.00	80.42	0.00	0.00
DELTA	4.59		0.00		4.59	0.00	67.52	0.00	0.00
DICKENS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
DUVAL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
EASTLAND	0.00		0.00		0.00	0.00	0.00	0.00	0.00
EDWARDS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
FISHER	0.00		0.00		0.00	0.00	0.00	0.00	0.00
FOARD	0.00		0.00		0.00	0.00	0.00	0.00	0.00
GLASSCOCK	0.00		0.00		0.00	0.00	0.00	0.00	0.00
GOLIAD	0.00		0.00		0.00	0.00	0.00	0.00	0.00
HALL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
HUDSPETH	0.00		0.00		0.00	0.00	0.00	0.00	0.00
IRION	0.00		0.00		0.00	0.00	0.00	0.00	0.00
JEFF DAVIS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
KENEDY	0.00		0.00		0.00	0.00	0.00	0.00	0.00
KENT	0.00		0.00		0.00	0.00	0.00	0.00	0.00
KING	0.00		0.00		0.00	0.00	0.00	0.00	0.00
KINNEY	0.00		0.00		0.00	0.00	0.00	0.00	0.00
KNOX	0.00		0.00		0.00	0.00	0.00	0.00	0.00
LA SALLE	3.94		196.51		200.44	0.00	59.53	0.00	0.00
LEON	0.00		0.00		0.00	0.00	0.00	0.00	0.00
LOVING	0.00		0.00		0.00	0.00	0.00	0.00	0.00
MENARD	0.00		0.00		0.00	0.00	0.00	0.00	0.00
MILLS	0.00		0.00		0.00	0.00	0.00	0.00	0.00
MONTAGUE	11.46		0.00		11.46	0.00	168.97	0.00	0.00
MOTLEY	0.00		0.00		0.00	0.00	0.00	0.00	0.00
REAL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
SCHLEICHER	5.10		0.00		5.10	0.00	87.31	0.00	0.00
SHACKELFORD	0.00		0.00		0.00	0.00	0.00	0.00	0.00
STARR	1.93		0.00		1.93	0.00	15.34	0.00	0.00
STERLING	0.00		0.00		0.00	0.00	0.00	0.00	0.00
STONEWALL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
SUTTON	0.00		0.00		0.00	0.00	0.00	0.00	0.00
TERRELL	0.00		0.00		0.00	0.00	0.00	0.00	0.00
THROCKMORTON	0.00		0.00		0.00	0.00	0.00	0.00	0.00
ZAPATA	0.00		0.00		0.00	0.00	0.00	0.00	0.00
TOTAL	**75,591.15**	**15.35**	**119,591.95**	**27.58**	**195,183.10**	**42.93**	**1,789,709.33**	**8.23**	**51.16**



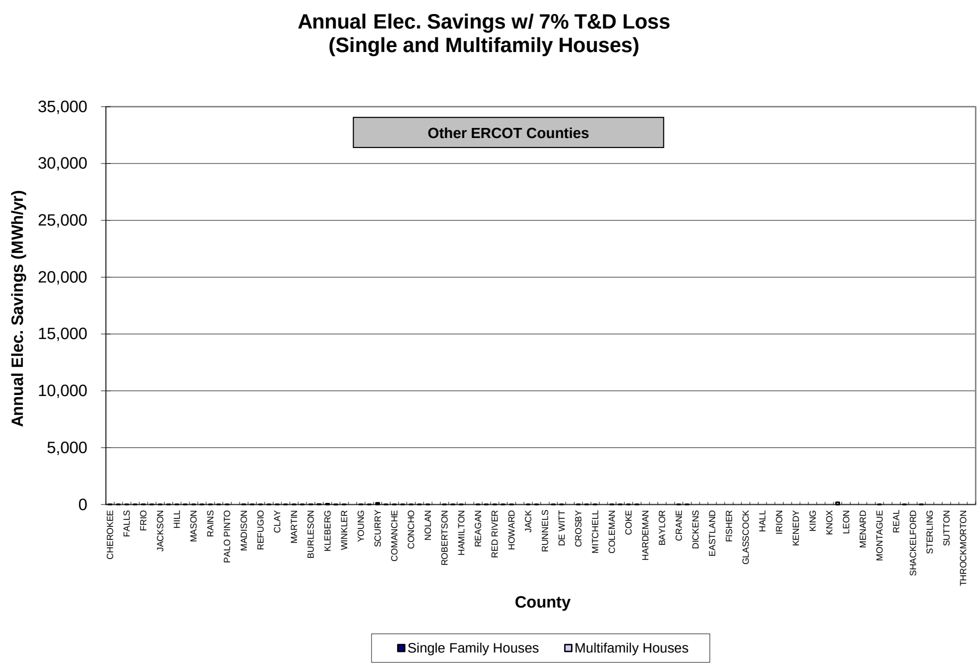


Figure 49: 2012 Annual Electricity Reductions from the 2006 IECC for Single-family and Multi-family Residences by County

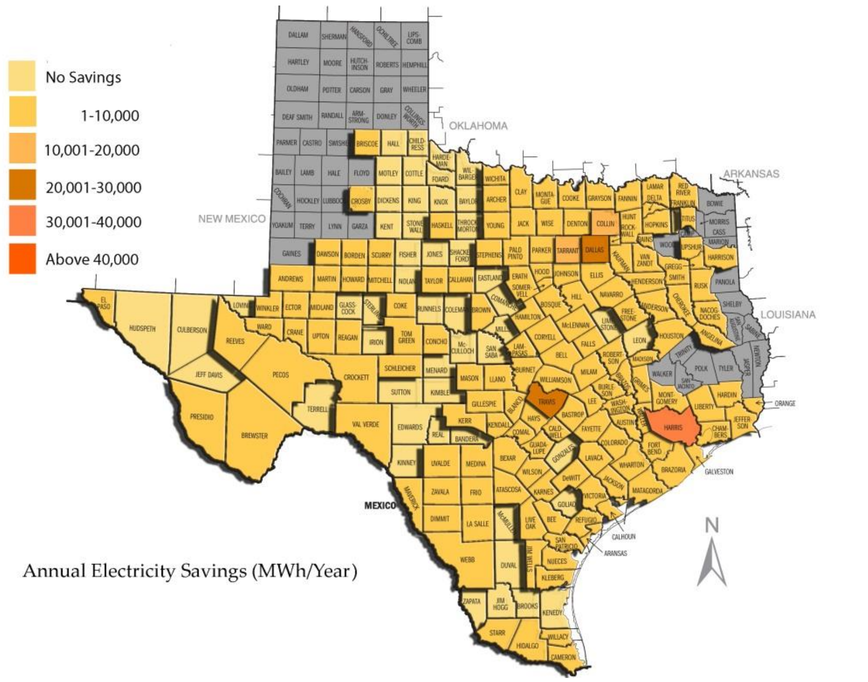
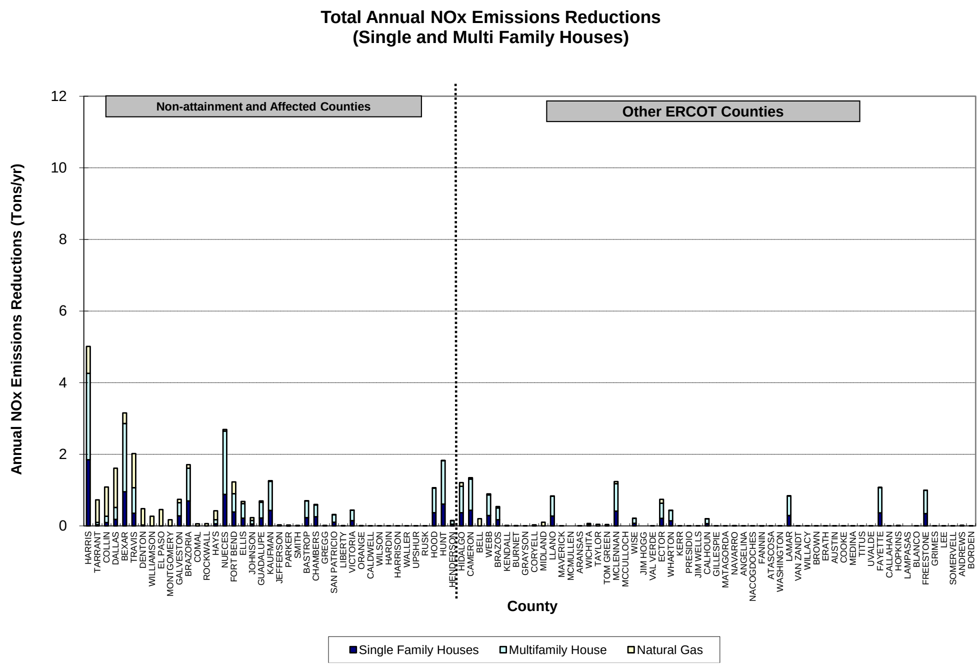


Figure 50: 2012 Annual Electricity Reductions from the 2006 IECC for Single-family and Multi-family Residences by County



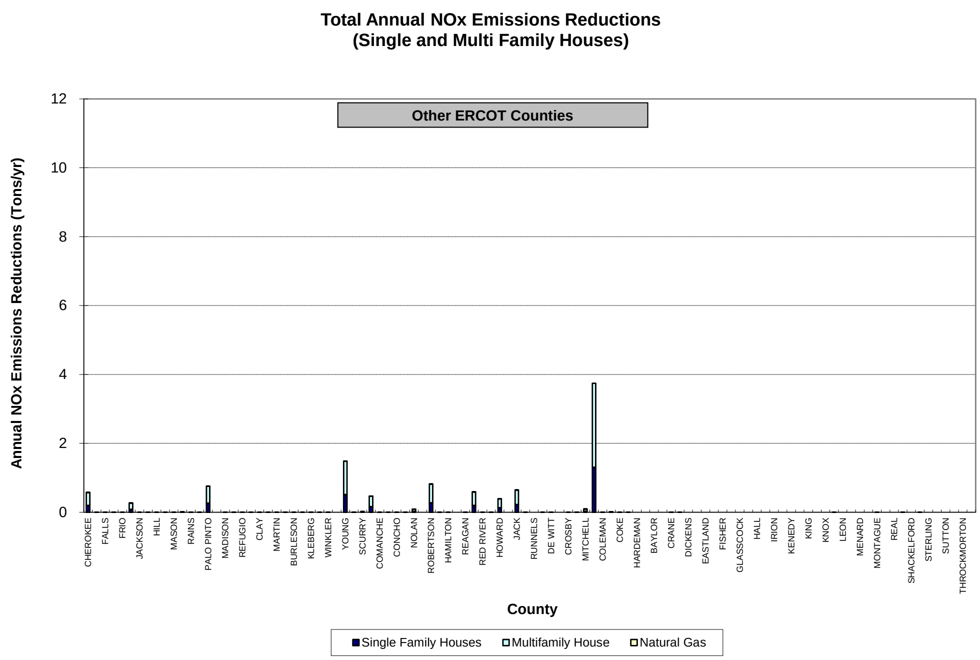


Figure 51: 2012 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the 2006 IECC for Single-family and Multi-family Residences by County (using 2008 Base Year and 2010 eGRID)

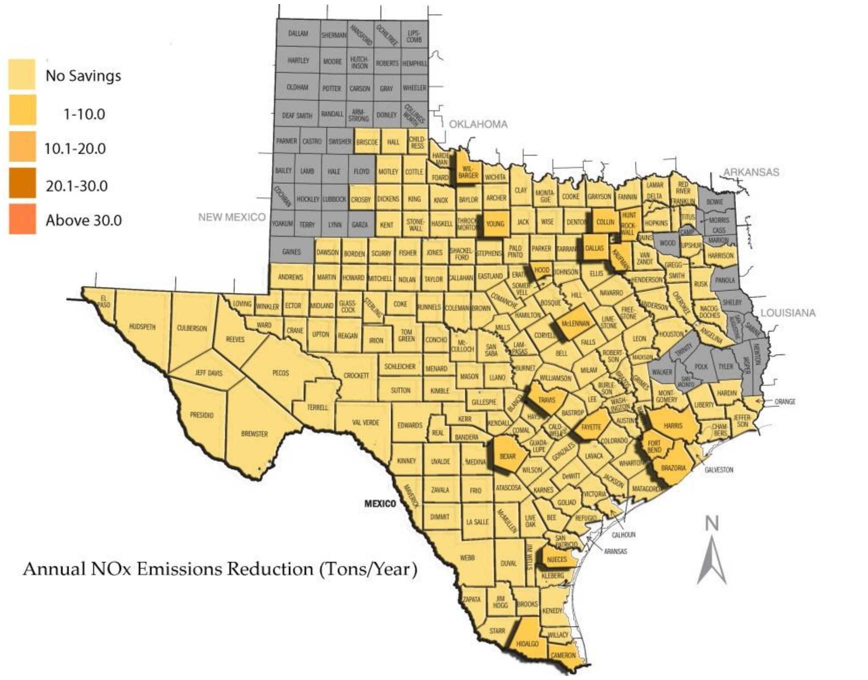


Figure 52: 2012 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the 2006 IECC for Single-family and Multi-family Residences by County (Using 2008 Base year and 2010 eGRID)

4.1.5 2012 Results for Commercial Construction

This section reports on the calculated energy and emissions savings from new commercial construction in 2012 that was built to meet the new ASHRAE Standard 90.1-2007 energy code. To determine the energy and emissions savings from new commercial construction in all counties in ERCOT region as well as the 41 non-attainment and affected counties, data from two sources were merged into one analysis as shown in Figure 53. In this figure, the analysis covers results shown in Figure 54 and in to Table 21

Beginning in the upper left of Figure 53, the Dodge database of the square footage of new commercial construction in Texas (Dodge 2012)[26] was categorized with the energy savings calculations published by the United States Department of Energy (DOE) in a report. This allowed for the new construction to be tracked by county, and energy savings to be calculated by building type. In the next block in Figure 53 and Table 17, the categories from the Dodge and DOE database can be seen. This resulted in 6 Dodge categories being categorized into 7 DOE energy use categories. In the third and fourth DOE category, the Dodge “stores and restaurant” category had to be split into two categories to match the two DOE categories for “retail” and “food”. To accomplish this, information published in the 1999 and 2003 CBECS database (Table 18) by the U.S.D.O.E’s EIA was used to determine the percentages used to split the Dodge conditioned area for each county as shown (i.e., 21.06% for food and 78.94% for retail). The square footage of all DOE building types is shown by individual graphs of each building type in Figure 54

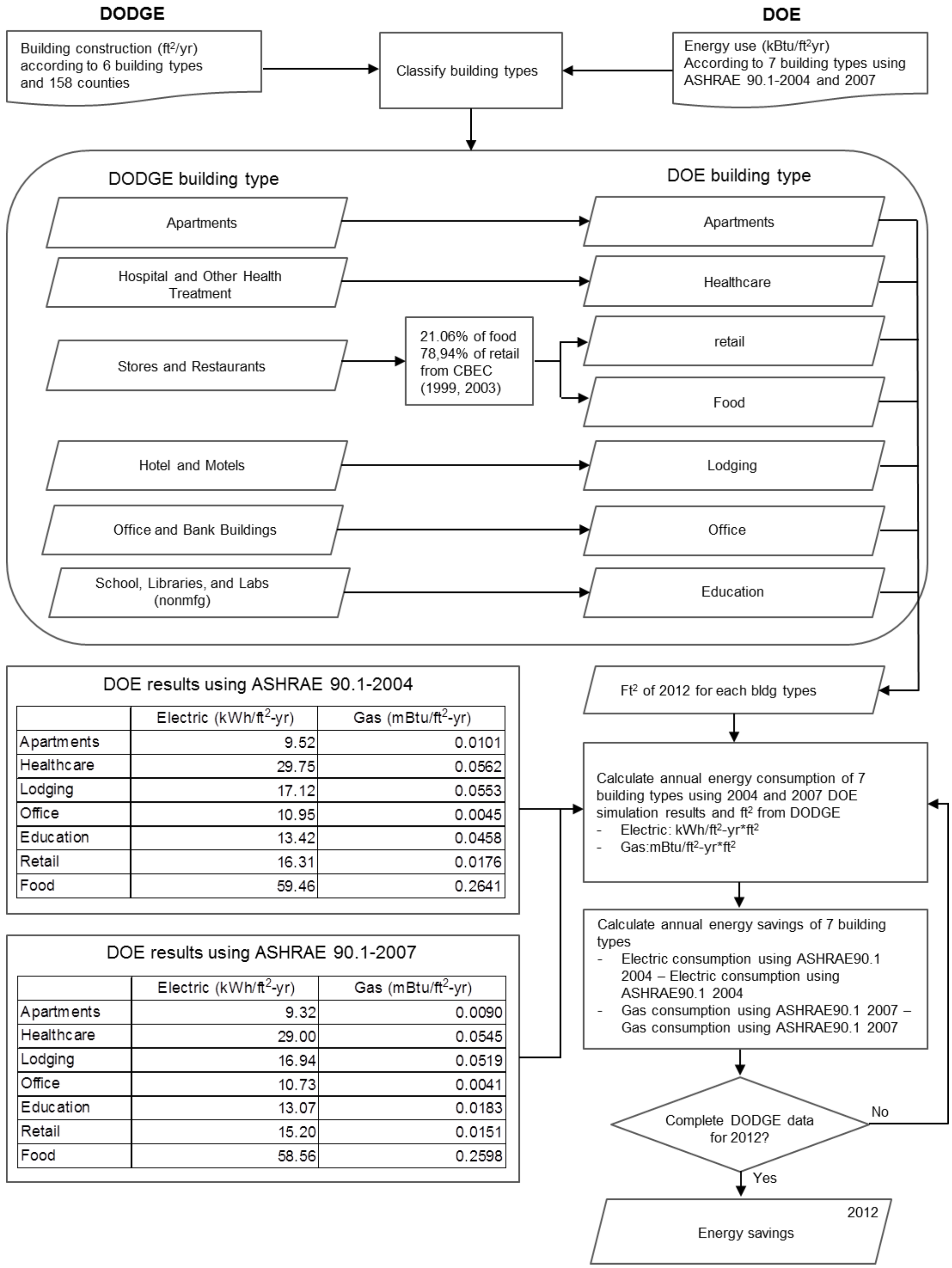
In the next step the DOE energy savings, which represent buildings built to comply with the ASHRAE Standard 90.1-2004 versus ASHRAE Standard 90.1-2007, which are expressed per square foot, were then multiplied by the published square feet of new construction. Table 19 toTable 21 show the annual energy use calculated for new construction, by building type, for ASHRAE Standard 90.1-2004 and ASHRAE Standard 90.1-2007. Table 22 shows the county-wide annual electricity and natural gas savings by building type[27] [28].

In the next calculation step, CM Zones were assigned to each county as shown in Table 19. In the case where more than one provider was shown in a county, a percentage of electricity use was allocated. In Table 24, the total electricity savings by CM Zones is shown for 2012 for all estimated new commercial construction. Table 24 shows the calculated annual NOx emissions reductions from electricity using the 2010 eGRID table for Texas.

Table 25 Table 25: 2012 Annual NOx Reductions from the ASHRAE Standard 90.1-2007 for Commercial Buildings by County using 2010 eGRID (w/7% T&D)shows the transformation of the annual county-wide electricity and natural gas savings, along with the associated 2012 NOx emissions reductions with 7% T&D losses. Figure 55 shows the bar chart of the annual electricity savings for 2012. Figure 56 presents the NOx emissions reductions from the electricity and natural gas savings using the 2010 eGRID for Texas.

Using the 2010 eGRID, the total NOx reductions from electricity and natural gas savings from new commercial construction in 2012 are calculated to be 34.27 tons NOx/year which represents 7.05 tons NOx/year from electricity savings and 27.22 tons NOx/year from natural gas savings.

[26] The square footage of new commercial construction of the Dodge 2011 was regarded as the square footage of new commercial construction for 2012 in this report.
[27] In this table (-) values are savings, (+) values are increased energy use.
[28] In a similar fashion as the proceeding table, in this table (-) values are savings, (+) values are increased energy use.



DOE results using ASHRAE 90.1-2004

	Electric (kWh/ft²-yr)	Gas (mBtu/ft²-yr)
Apartments	9.52	0.0101
Healthcare	29.75	0.0562
Lodging	17.12	0.0553
Office	10.95	0.0045
Education	13.42	0.0458
Retail	16.31	0.0176
Food	59.46	0.2641

DOE results using ASHRAE 90.1-2007

	Electric (kWh/ft²-yr)	Gas (mBtu/ft²-yr)
Apartments	9.32	0.0090
Healthcare	29.00	0.0545
Lodging	16.94	0.0519
Office	10.73	0.0041
Education	13.07	0.0183
Retail	15.20	0.0151
Food	58.56	0.2598

Figure 53: Analysis Method for Calculating the 2012 Energy and Emissions Savings from Commercial Buildings

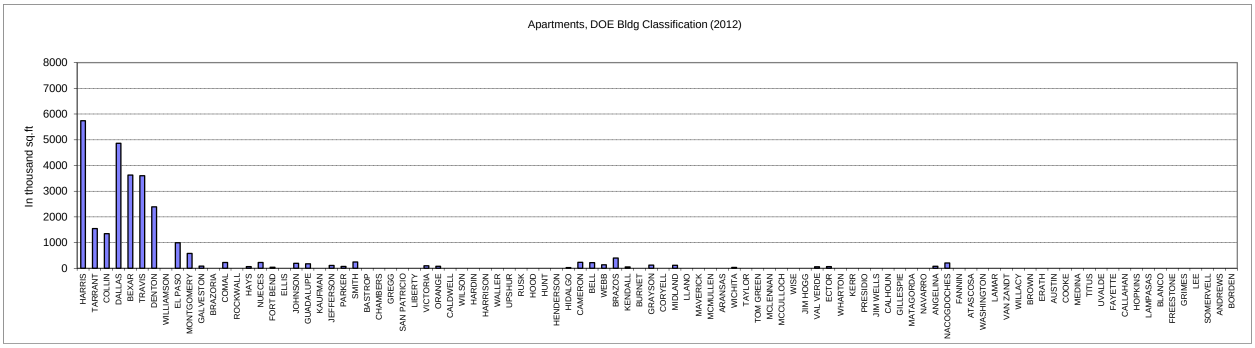
Table 17: Commercial Building Descriptions from USDOE Report and Dodge (2012)

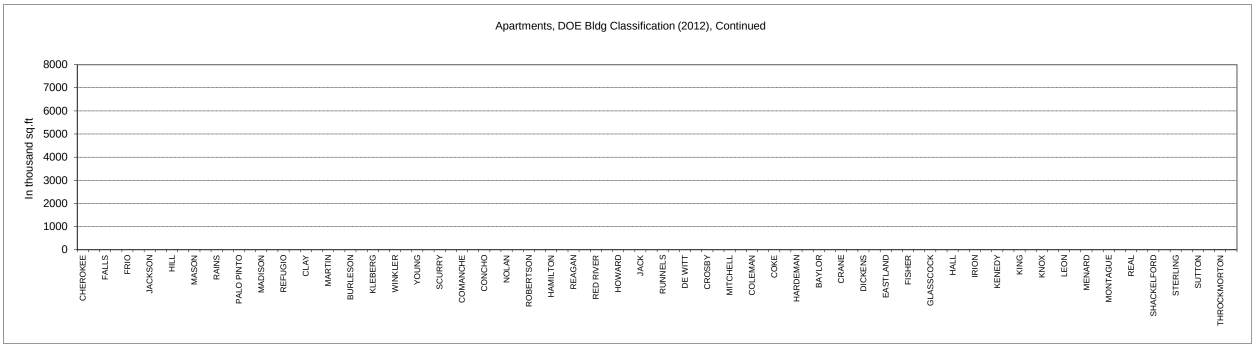
No	DOE Bldg Types	Dodge Bldg Types
1	Apartments	Apartments
2	Healthcare	Hospitals and Other Health treatment
3	Lodging	Hotels and Motels
4	Office	Office and Bank Buildings
5	Education	School, Libraries, and Labs (nonmfg)
6	Retail	Stores and Restraunts
7	Food	Stores and Restraunts

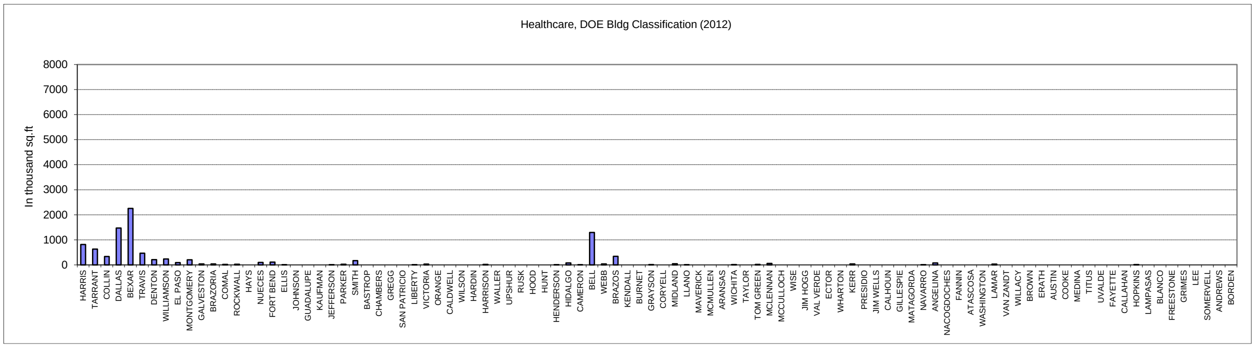
Table 18: Floor Area from CBECS (1999, 2003) database for Retail and Food Type Commercial Buildings

		CBECS (1999)		CBECS (2003)	
		All (million square feet)	South (million square feet)	All (million square feet)	South (million square feet)
Food	Food Sales	994	392	1,255	487
	Food Service	1,851	676	1,654	764
Retail	Retail (Other Than Mall)	4,766	1,566	4,317	1,844
	Enclosed and Strip Malls	5,631	2,513	6,875	3,251

	South		All	
	Food %	Retail %	Food %	Retail %
CBECS (1999)	20.75	79.25	21.48	78.52
CBECS (2003)	19.71	80.29	20.63	79.37
Average	20.23	79.77	21.06	78.94







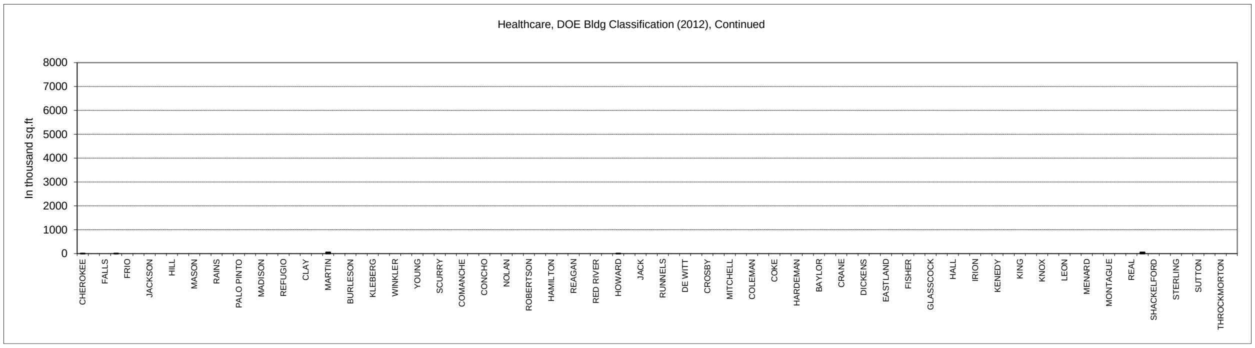
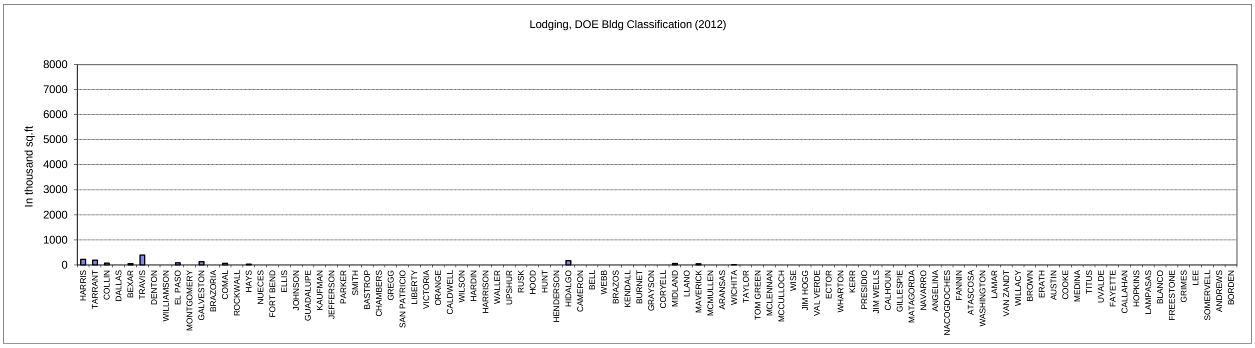
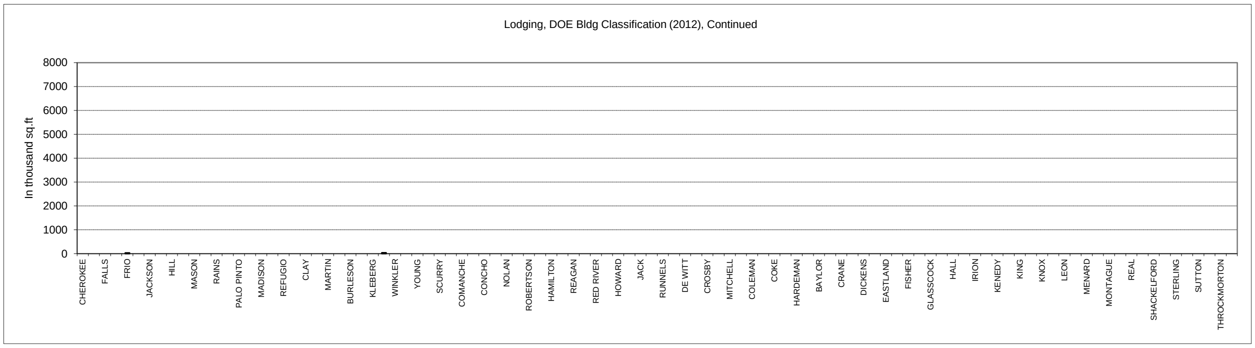
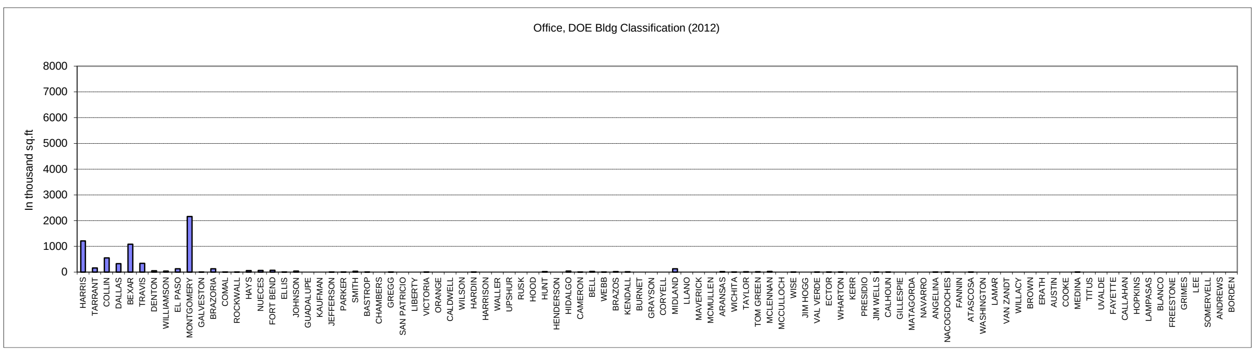


Figure 54: 2012 New Commercial Building Constructions (sq. ft. x 1000) (Dodge 2012)







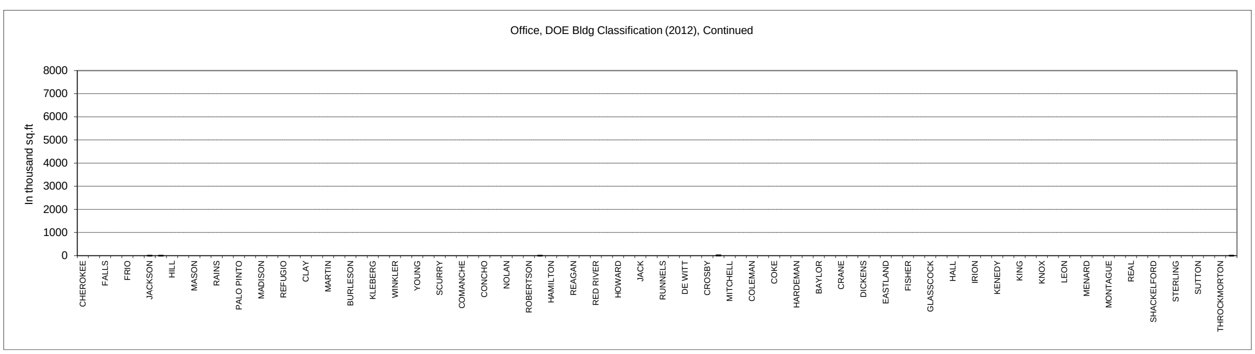


Figure 54: 2012 New Commercial Building Constructions (sq. ft. x 1000) (Dodge 2012) (Continued)

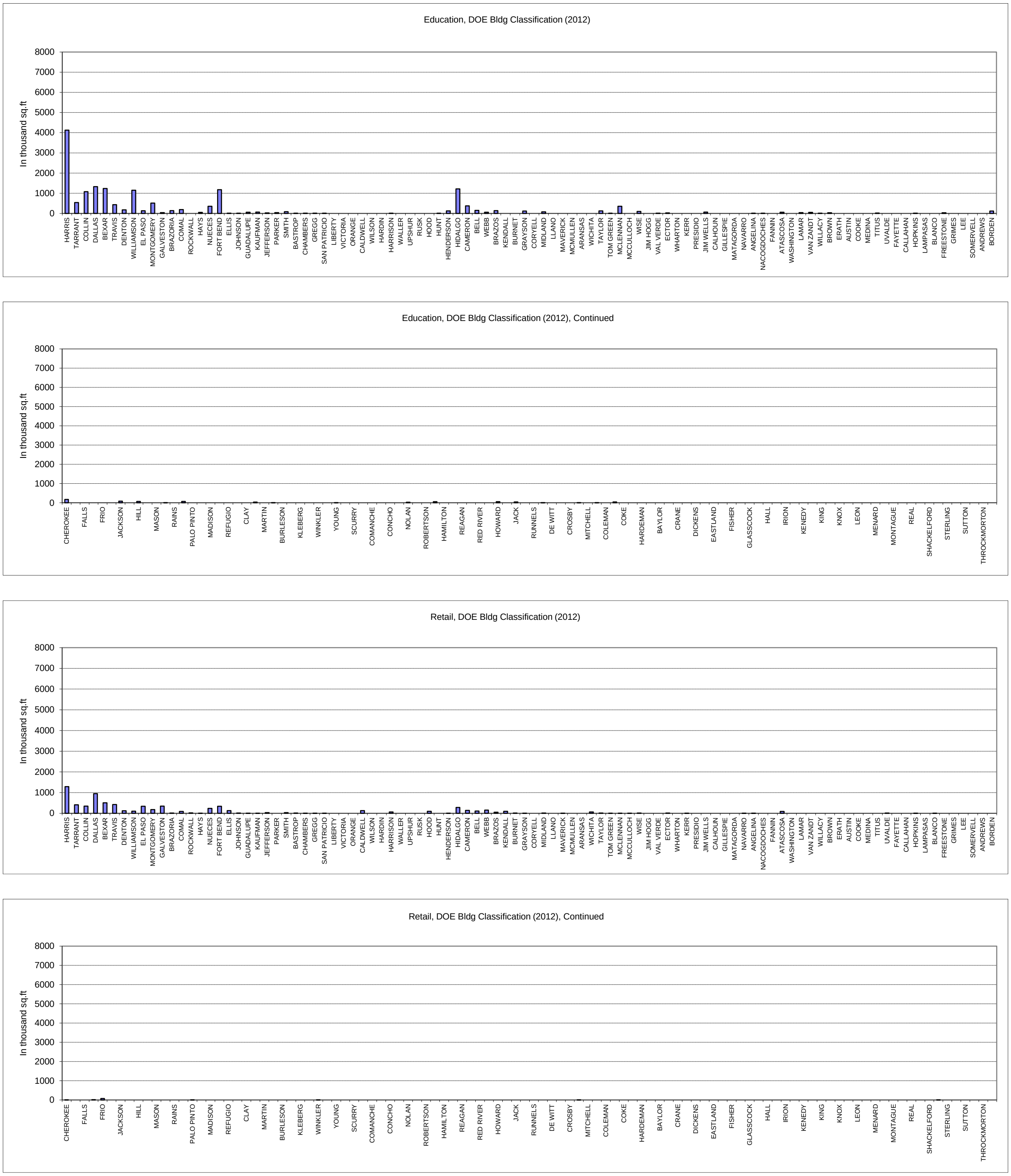
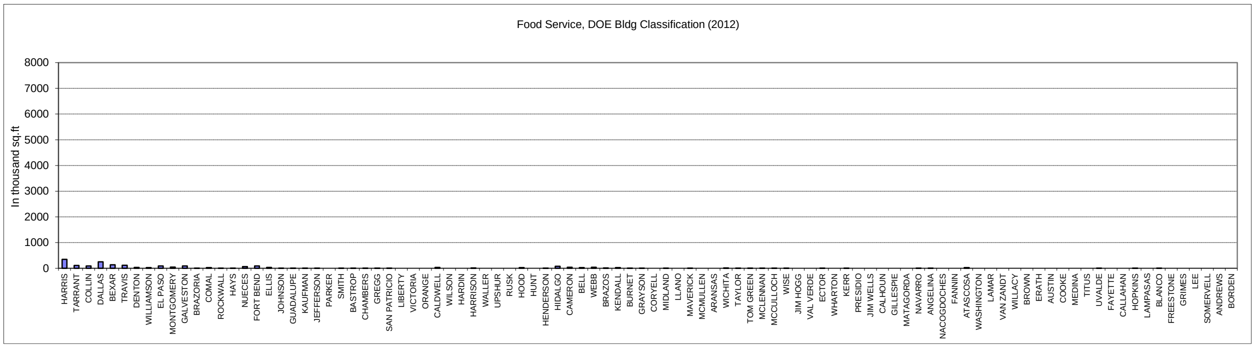


Figure 54: 2012 New Commercial Building Constructions (sq. ft. x 1000) (Dodge 2012) (Continued)



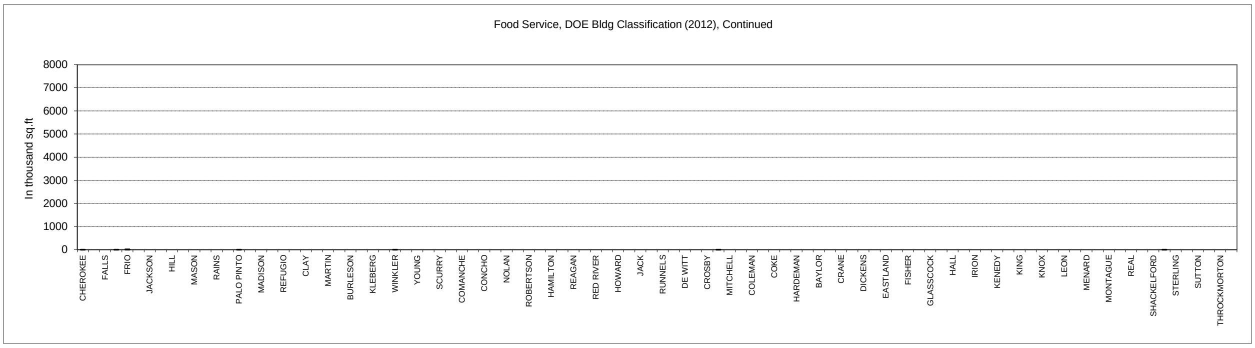


Figure 54: 2012 New Commercial Building Constructions (sq. ft. x 1000) (Dodge 2012) (Continued)

Table 19: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 Code-Compliant Apartment, Healthcare, and Lodging Building Types

Non-attainment Counties	Apartments				Healthcare				Lodging			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
Brazoria	0	0	0	0	1279109	1246974	2414	2344	0	0	0	0
Chambers	0	0	0	0	0	0	0	0	0	0	0	0
Collin	12805160	12529357	13578	12100	9985977	9735097	18850	18296	1232306	1219645	3978	3737
Dallas	46339174	45341100	49138	43786	43718766	42620413	82524	80099	0	0	0	0
Denton	22748114	22258155	24122	21495	6193269	6037674	11690	11347	0	0	0	0
El Paso	9437186	9233924	10007	8917	2840813	2769442	5362	5205	1427421	1412756	4608	4328
Fort Bend	388612	380242	412	367	3367330	3282732	6356	6169	0	0	0	0
Galveston	790560	773532	838	747	1154173	1125177	2179	2115	2245535	2222464	7249	6809
Hardin	0	0	0	0	0	0	0	0	0	0	0	0
Harris	54680054	53502330	57982	51667	24344722	23733106	45953	44603	3873206	3833412	12503	11745
Jefferson	1047730	1025163	1111	990	124936	121797	236	229	0	0	0	0
Liberty	0	0	0	0	187404	182696	354	343	0	0	0	0
Montgomery	5526297	5407269	5860	5222	6035611	5883978	11393	11058	0	0	0	0
Orange	761985	745573	808	720	0	0	0	0	0	0	0	0
Tarrant	14704408	14387698	15592	13894	18740439	18269620	35375	34335	3241649	3208344	10464	9830
Waller	0	0	0	0	0	0	0	0	0	0	0	0

Affected Counties	Apartments				Healthcare				Lodging			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
Bastrop	0	0	0	0	0	0	0	0	0	0	0	0
Bexar	34514117	33770736	36598	32612	67150263	65463237	126753	123028	936210	926592	3022	2839
Caldwell	0	0	0	0	0	0	0	0	0	0	0	0
Comal	2162133	2115564	2293	2043	553289	539389	1044	1014	1174114	1162051	3790	3560
Ellis	0	0	0	0	77341	75398	146	142	0	0	0	0
Gregg	0	0	0	0	0	0	0	0	0	0	0	0
Guadalupe	1676367	1640261	1778	1584	0	0	0	0	0	0	0	0
Harrison	0	0	0	0	565188	550989	1067	1036	0	0	0	0
Hays	603873	590867	640	571	0	0	0	0	588768	582719	1901	1785
Henderson	0	0	0	0	297467	289994	562	545	0	0	0	0
Hood	0	0	0	0	0	0	0	0	0	0	0	0
Hunt	0	0	0	0	0	0	0	0	0	0	0	0
Johnson	1819240	1780056	1929	1719	0	0	0	0	0	0	0	0
Kaufman	0	0	0	0	0	0	0	0	0	0	0	0
Nueces	2142131	2095993	2271	2024	2876509	2804242	5430	5270	0	0	0	0
Parker	707694	692451	750	669	871579	849682	1645	1597	0	0	0	0
Rockwall	0	0	0	0	755567	736585	1426	1384	0	0	0	0
Rusk	0	0	0	0	0	0	0	0	0	0	0	0
San Patricio	0	0	0	0	0	0	0	0	0	0	0	0
Smith	2348819	2298229	2491	2219	5205677	5074894	9826	9538	0	0	0	0
Travis	34295999	33557316	36367	32406	13841152	13493419	26127	25359	6736605	6667393	21746	20428
Upshur	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	952481	931966	1010	900	987591	962780	1864	1809	0	0	0	0
Williamson	0	0	0	0	7094595	6916356	13392	12998	0	0	0	0
Wilson	0	0	0	0	0	0	0	0	0	0	0	0

Table 20: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 Code-Compliant Apartment, Healthcare, and Lodging Building Types (Continued)

Other ERCOT Counties	Apartments				Healthcare				Lodging			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
ANDERSON	0	0	0	0	0	0	0	0	0	0	0	0
ANDREWS	0	0	0	0	0	0	0	0	0	0	0	0
ANGELINA	761985	745573	808	720	2349992	2290952	4436	4306	0	0	0	0
ARANSAS	0	0	0	0	0	0	0	0	0	0	0	0
ARCHER	0	0	0	0	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	0	0	0	0	0	0	0	0
AUSTIN	0	0	0	0	0	0	0	0	0	0	0	0
BANDERA	0	0	0	0	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0	0	0	0	0
BEE	0	0	0	0	0	0	0	0	0	0	0	0
BELL	2074505	2029823	2200	1960	38581506	37612217	72827	70687	0	0	0	0
BLANCO	0	0	0	0	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0	0	0	0	0
BRAZOS	3783256	3701771	4012	3575	10113887	9859795	19091	18530	0	0	0	0
BREWSTER	0	0	0	0	0	0	0	0	753076	745339	2431	2284
BRISCOE	0	0	0	0	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0	0	0	0	0
BROWN	0	0	0	0	0	0	0	0	0	0	0	0
BURLESON	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	0	0	0	0	0	0	0	0	0	0	0	0
CALHOUN	0	0	0	0	0	0	0	0	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	2187850	2140727	2320	2067	47595	46399	90	87	0	0	0	0
CHEROKEE	0	0	0	0	297467	289994	562	545	0	0	0	0
CHILDRESS	0	0	0	0	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	0	0	0	0	0	0
COLORADO	0	0	0	0	303417	295794	573	556	0	0	0	0
COMANCHE	0	0	0	0	0	0	0	0	0	0	0	0
CONCHO	0	0	0	0	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	0	0	0	0	0	0	0	0
CORYELL	0	0	0	0	0	0	0	0	0	0	0	0
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	0	0	0	0	0	0	0	0	0	0	0	0
CROSBY	0	0	0	0	0	0	0	0	0	0	0	0
CULBERSON	0	0	0	0	0	0	0	0	0	0	0	0
DAWSON	0	0	0	0	0	0	0	0	0	0	0	0
DE WITT	0	0	0	0	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0	0	0	0	0
ECTOR	622923	609506	661	589	0	0	0	0	0	0	0	0
EDWARDS	0	0	0	0	0	0	0	0	0	0	0	0
ERATH	0	0	0	0	0	0	0	0	0	0	0	0
FALLS	0	0	0	0	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0	0	0	0	0
FAYETTE	0	0	0	0	0	0	0	0	0	0	0	0
FISHER	0	0	0	0	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	0	0	0	0	0	0	0	0
FRIO	0	0	0	0	0	0	0	0	667499	660641	2155	2024
GILLESPIE	0	0	0	0	0	0	0	0	0	0	0	0
GLASSCOCK	0	0	0	0	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0	0	0	0	0
GONZALES	0	0	0	0	0	0	0	0	0	0	0	0
GRAYSON	1190602	1164958	1263	1125	348037	339293	657	638	0	0	0	0
GRIMES	0	0	0	0	0	0	0	0	0	0	0	0
HALL	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0	0	0	0	0
HIDALGO	254313	248835	270	240	2466004	2404050	4655	4518	2960957	2930536	9558	8979
HILL	0	0	0	0	0	0	0	0	0	0	0	0
HOPKINS	0	0	0	0	461074	449491	870	845	0	0	0	0
HOUSTON	0	0	0	0	0	0	0	0	0	0	0	0
HOWARD	0	0	0	0	32721	31899	62	60	0	0	0	0
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0
IRION	0	0	0	0	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0	0	0	0	0

Table 20: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 Code-Compliant Apartment, Healthcare, and Lodging Building Types (Continued)

Other ERCOT Counties	Apartments				Healthcare				Lodging			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
JIM WELLS	0	0	0	0	0	0	0	0	0	0	0	0
JONES	0	0	0	0	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0	0	0	0	0
KENDALL	476241	465983	505	450	0	0	0	0	0	0	0	0
KENEDY	0	0	0	0	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0	0	0	0	0
KERR	0	0	0	0	1189869	1159976	2246	2180	0	0	0	0
KIMBLE	0	0	0	0	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0	0	0	0	0
KLEBERG	0	0	0	0	0	0	0	0	0	0	0	0
KNOX	0	0	0	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0	0	0	0	0
LAMAR	0	0	0	0	922149	898981	1741	1690	0	0	0	0
LAMPASAS	0	0	0	0	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0	0	0	0	0
LEE	0	0	0	0	0	0	0	0	0	0	0	0
LEON	0	0	0	0	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	267721	260995	505	491	0	0	0	0
LOVING	0	0	0	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	1820500	1774763	3436	3335	0	0	0	0
MASON	0	0	0	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0	0	0	0	0
MAVERICK	0	0	0	0	0	0	0	0	842076	833424	2718	2553
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	0	0
MCLENNAN	0	0	0	0	1784804	1739964	3369	3270	0	0	0	0
MCMULLEN	0	0	0	0	0	0	0	0	0	0	0	0
MEDINA	0	0	0	0	0	0	0	0	0	0	0	0
MENARD	0	0	0	0	0	0	0	0	0	0	0	0
MIDLAND	1109641	1085741	1177	1049	1401071	1365872	2645	2567	1064575	1053638	3437	3228
MILAM	0	0	0	0	0	0	0	0	0	0	0	0
MILLS	0	0	0	0	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	0	0	0	0	0	0
MOTLEY	0	0	0	0	0	0	0	0	0	0	0	0
NACOGDOCHES	1943062	1901212	2060	1836	0	0	0	0	0	0	0	0
NAVARRO	0	0	0	0	285569	278394	539	523	0	0	0	0
NOLAN	0	0	0	0	0	0	0	0	0	0	0	0
PALO PINTO	0	0	0	0	0	0	0	0	0	0	0	0
PECOS	0	0	0	0	0	0	0	0	0	0	0	0
PRESIDIO	0	0	0	0	0	0	0	0	0	0	0	0
RAINS	0	0	0	0	0	0	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0	0	0	0	0
REEVES	0	0	0	0	0	0	0	0	0	0	0	0
REFUGIO	0	0	0	0	0	0	0	0	0	0	0	0
ROBERTSON	0	0	0	0	0	0	0	0	0	0	0	0
RUNNELS	0	0	0	0	0	0	0	0	0	0	0	0
SAN SABA	0	0	0	0	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	1749108	1705165	3302	3205	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0	0	0	0
SOMERVELL	0	0	0	0	0	0	0	0	0	0	0	0
STARR	0	0	0	0	0	0	0	0	0	0	0	0
STEPHENS	0	0	0	0	0	0	0	0	0	0	0	0
STERLING	0	0	0	0	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0	0	0	0	0
TAYLOR	0	0	0	0	0	0	0	0	0	0	0	0
TERRELL	0	0	0	0	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0	0	0	0	0
TOM GREEN	0	0	0	0	538416	524889	1016	986	0	0	0	0
UPTON	0	0	0	0	0	0	0	0	0	0	0	0
UVALDE	0	0	0	0	0	0	0	0	0	0	0	0
VAL VERDE	573394	561044	608	542	0	0	0	0	0	0	0	0
VAN ZANDT	0	0	0	0	0	0	0	0	0	0	0	0
WARD	0	0	0	0	0	0	0	0	0	0	0	0
WASHINGTON	0	0	0	0	0	0	0	0	0	0	0	0
WEBB	1268705	1241379	1345	1199	1267211	1235374	2392	2322	0	0	0	0
WHARTON	0	0	0	0	0	0	0	0	0	0	0	0
WICHITA	320034	313141	339	302	461074	449491	870	845	22250	22021	72	67
WILBARGER	0	0	0	0	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	0	0	0	0	0	0	0	0
WINKLER	0	0	0	0	0	0	0	0	0	0	0	0
WISE	0	0	0	0	0	0	0	0	0	0	0	0
YOUNG	0	0	0	0	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0	0	0	0	0
Total	267018645	261267474	283143	252306	284937957	277779417	537850	522045	27766246	27480977	89632	84197

Table 20: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 Code-Compliant Office and Education Building Types

Non-attainment Counties	**Office**				**Education**			
	Electricity (kWh/yr), DOE		**Gas (mBtu/yr), DOE**		**Electricity (kWh/yr), DOE**		**Gas (mBtu/yr), DOE**	
	2004 (Annual)	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**
Brazoria	1423642	1394433	585	529	1903333	1853464	6494	2588
Chambers	0	0	0	0	216105	210443	737	294
Collin	6063621	5939211	2492	2252	14453522	14074827	49317	19652
Dallas	3620432	3546150	1488	1344	17798449	17332114	60731	24200
Denton	600120	587807	247	223	2382522	2320098	8130	3239
El Paso	1437879	1408377	591	534	1773134	1726676	6050	2411
Fort Bend	788479	772301	324	293	15811895	15397610	53952	21499
Galveston	93084	91174	38	35	559725	545060	1910	761
Hardin	37234	36470	15	14	0	0	0	0
Harris	13278202	13005768	5456	4931	55398008	53946532	189026	75321
Jefferson	102940	100828	42	38	387915	377751	1324	527
Liberty	0	0	0	0	0	0	0	0
Montgomery	23631366	23146512	9711	8775	6893879	6713253	23523	9373
Orange	0	0	0	0	0	0	0	0
Tarrant	1781743	1745186	732	662	7226761	7037413	24659	9826
Waller	0	0	0	0	0	0	0	0
Affected Counties	**Office**				**Education**			
	Electricity (kWh/yr), DOE		**Gas (mBtu/yr), DOE**		**Electricity (kWh/yr), DOE**		**Gas (mBtu/yr), DOE**	
	2004 (Annual)	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**
Bastrop	61326	60068	25	23	64429	62741	220	88
Bexar	11834848	11592027	4863	4395	16554168	16120435	56485	22508
Caldwell	0	0	0	0	0	0	0	0
Comal	98560	96538	41	37	2603996	2535769	8885	3541
Ellis	96370	94392	40	36	191944	186915	655	261
Gregg	14236	13944	6	5	161072	156852	550	219
Guadalupe	0	0	0	0	765092	745046	2611	1040
Harrison	0	0	0	0	13423	13071	46	18
Hays	654875	641439	269	243	748985	729360	2556	1018
Henderson	0	0	0	0	1661725	1618187	5670	2259
Hood	0	0	0	0	0	0	0	0
Hunt	219022	214528	90	81	26845	26142	92	37
Johnson	458851	449436	189	170	67113	65355	229	91
Kaufman	0	0	0	0	880527	857456	3004	1197
Nueces	737009	721887	303	274	4747595	4623204	16199	6455
Parker	82133	80448	34	31	544960	530682	1859	741
Rockwall	49280	48269	20	18	0	0	0	0
Rusk	0	0	0	0	0	0	0	0
San Patricio	0	0	0	0	134227	130710	458	183
Smith	395335	387223	162	147	1187906	1156781	4053	1615
Travis	3706945	3630889	1523	1377	5850938	5697638	19964	7955
Upshur	0	0	0	0	0	0	0	0
Victoria	54755	53632	23	20	0	0	0	0
Williamson	429283	420475	176	159	15417269	15013323	52606	20962
Wilson	0	0	0	0	0	0	0	0

Table 21: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 Code-Compliant Office and Education Building Types (Continued)

Other ERCOT Counties	Office				Education			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
ANDERSON	15332	15017	6	6	0	0	0	0
ANDREWS	0	0	0	0	0	0	0	0
ANGELINA	32853	32179	14	12	34899	33985	119	47
ARANSAS	251875	246707	104	94	0	0	0	0
ARCHER	0	0	0	0	0	0	0	0
ATASCOSA	7666	7508	3	3	845628	823471	2885	1150
AUSTIN	0	0	0	0	0	0	0	0
BANDERA	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0
BEE	0	0	0	0	536906	522839	1832	730
BELL	286919	281032	118	107	2030849	1977639	6930	2761
BLANCO	0	0	0	0	0	0	0	0
BORDEN	0	0	0	0	1583874	1542375	5404	2154
BOSQUE	0	0	0	0	0	0	0	0
BRAZOS	226688	222037	93	84	1845616	1797259	6298	2509
BREWSTER	0	0	0	0	0	0	0	0
BRISCOE	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0
BROWN	0	0	0	0	476504	464020	1626	648
BURLESON	0	0	0	0	0	0	0	0
BURNET	0	0	0	0	0	0	0	0
CALHOUN	82133	80448	34	31	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0
CAMERON	21902	21453	9	8	4997257	4866324	17051	6794
CHEROKEE	0	0	0	0	2355677	2293956	8038	3203
CHILDRESS	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	0	0
COLORADO	0	0	0	0	0	0	0	0
COMANCHE	0	0	0	0	0	0	0	0
CONCHO	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	0	0	0	0
CORYELL	0	0	0	0	0	0	0	0
COTTLE	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0
CROCKETT	0	0	0	0	0	0	0	0
CROSBY	0	0	0	0	0	0	0	0
CULBERSON	0	0	0	0	0	0	0	0
DAWSON	229973	225255	95	85	68456	66662	234	93
DE WITT	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0
ECTOR	68992	67576	28	26	402680	392129	1374	548
EDWARDS	0	0	0	0	0	0	0	0
ERATH	0	0	0	0	0	0	0	0
FALLS	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0
FAYETTE	0	0	0	0	0	0	0	0
FISHER	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	461740	449642	1576	628
FRIO	0	0	0	0	0	0	0	0
GILLESPIE	0	0	0	0	0	0	0	0
GLASSCOCK	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0
GONZALES	0	0	0	0	134227	130710	458	183
GRAYSON	0	0	0	0	1597297	1555446	5450	2172
GRIMES	0	0	0	0	0	0	0	0
HALL	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0
HIDALGO	468707	459090	193	174	16315245	15887771	55670	22183
HILL	0	0	0	0	938244	913661	3201	1276
HOPKINS	0	0	0	0	167783	163387	573	228
HOUSTON	0	0	0	0	0	0	0	0
HOWARD	0	0	0	0	805360	784259	2748	1095
HUDSPETH	0	0	0	0	0	0	0	0
IRION	0	0	0	0	0	0	0	0
JACK	0	0	0	0	558383	543753	1905	759
JACKSON	37234	36470	15	14	1159718	1129332	3957	1577
JEFF DAVIS	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0

Table 21: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 Code-Compliant Office and Education Building Types (Continued)

Other ERCOT Counties	Office				Education			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
JIM WELLS	21902	21453	9	8	900661	877062	3073	1225
JONES	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0
KENDALL	173027	169477	71	64	0	0	0	0
KENEDY	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0
KERR	0	0	0	0	0	0	0	0
KIMBLE	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0
KLEBERG	0	0	0	0	0	0	0	0
KNOX	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0
LAMAR	0	0	0	0	561067	546367	1914	763
LAMPASAS	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	926164	901897	3160	1259
LEE	0	0	0	0	0	0	0	0
LEON	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0
LIVE OAK	29568	28961	12	11	778514	758117	2656	1059
LLANO	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0
MAVERICK	0	0	0	0	0	0	0	0
MCCULLOCH	0	0	0	0	0	0	0	0
MCLENNAN	277063	271378	114	103	4734173	4610133	16154	6437
MCMULLEN	0	0	0	0	0	0	0	0
MEDINA	41614	40760	17	15	0	0	0	0
MENARD	0	0	0	0	0	0	0	0
MIDLAND	1388599	1360108	571	516	1099316	1070513	3751	1495
MILAM	0	0	0	0	0	0	0	0
MILLS	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	0	0
MOTLEY	0	0	0	0	0	0	0	0
NACOGDOCHES	48185	47196	20	18	97985	95418	334	133
NAVARRO	0	0	0	0	0	0	0	0
NOLAN	0	0	0	0	362412	352916	1237	493
PALO PINTO	0	0	0	0	0	0	0	0
PECOS	0	0	0	0	107381	104568	366	146
PRESIDIO	0	0	0	0	0	0	0	0
RAINS	0	0	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0
REEVES	0	0	0	0	134227	130710	458	183
REFUGIO	0	0	0	0	0	0	0	0
ROBERTSON	0	0	0	0	0	0	0	0
RUNNELS	0	0	0	0	0	0	0	0
SAN SABA	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0
SOMERVELL	0	0	0	0	0	0	0	0
STARR	0	0	0	0	0	0	0	0
STEPHENS	0	0	0	0	0	0	0	0
STERLING	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0
TAYLOR	186169	182349	77	69	1688571	1644329	5762	2296
TERRELL	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	255031	248349	870	347
TOM GREEN	155506	152315	64	58	40268	39213	137	55
UPTON	0	0	0	0	563752	548981	1924	767
UVALDE	0	0	0	0	0	0	0	0
VAL VERDE	70087	68649	29	26	218789	213057	747	297
VAN ZANDT	0	0	0	0	758380	738510	2588	1031
WARD	0	0	0	0	0	0	0	0
WASHINGTON	0	0	0	0	0	0	0	0
WEBB	43804	42906	18	16	801333	780337	2734	1090
WHARTON	61326	60068	25	23	0	0	0	0
WICHITA	64611	63286	27	24	0	0	0	0
WILBARGER	0	0	0	0	9396	9150	32	13
WILLACY	0	0	0	0	233554	227435	797	318
WINKLER	0	0	0	0	0	0	0	0
WISE	19712	19308	8	7	1339582	1304483	4571	1821
YOUNG	0	0	0	0	51006	49670	174	69
ZAPATA	108416	106191	45	40	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0
Total	76171431	74608592	31300	28286	229405364	223394743	782763	311909

Table 21: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 Code-Compliant Retail and Food Service Building Types

Non-attainment Counties	**Retail**				**Food Service**			
	Electricity (kWh/yr), DOE		**Gas (mBtu/yr), DOE**		**Electricity (kWh/yr), DOE**		**Gas (mBtu/yr), DOE**	
	2004 (Annual)	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**
Brazoria	280667	261502	302	260	273005	268834	1213	1193
Chambers	136471	127153	147	126	132745	130717	590	580
Collin	5628797	5244441	6057	5211	5475121	5391470	24317	23916
Dallas	15481767	14424612	16659	14334	15059088	14829008	66882	65781
Denton	2035482	1896492	2190	1885	1979910	1949660	8793	8649
El Paso	5521938	5144878	5942	5112	5371179	5289116	23855	23462
Fort Bend	5596611	5214452	6022	5182	5443813	5360640	24178	23780
Galveston	5610773	5227647	6038	5195	5457589	5374205	24239	23840
Hardin	0	0	0	0	0	0	0	0
Harris	21056491	19618671	22658	19495	20481611	20168684	90966	89467
Jefferson	504686	470224	543	467	490907	483407	2180	2144
Liberty	0	0	0	0	0	0	0	0
Montgomery	2961170	2758969	3186	2742	2880324	2836318	12792	12582
Orange	0	0	0	0	0	0	0	0
Tarrant	6698681	6241269	7208	6202	6515795	6416243	28939	28462
Waller	0	0	0	0	0	0	0	0

Affected Counties	**Retail**				**Food Service**			
	Electricity (kWh/yr), DOE		**Gas (mBtu/yr), DOE**		**Electricity (kWh/yr), DOE**		**Gas (mBtu/yr), DOE**	
	2004 (Annual)	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**	**2004 (Annual)**	**2007 (Annual)**
Bastrop	190545	177534	205	176	185343	182511	823	810
Bexar	8295137	7728713	8926	7680	8068665	7945389	35836	35245
Caldwell	2059944	1919283	2217	1907	2003704	1973090	8899	8753
Comal	1457410	1357893	1568	1349	1417621	1395961	6296	6192
Ellis	2058657	1918083	2215	1906	2002452	1971857	8894	8747
Gregg	92697	86368	100	86	90167	88789	400	394
Guadalupe	48924	45583	53	45	47588	46861	211	208
Harrison	1040272	969238	1119	963	1011870	996411	4494	4420
Hays	173808	161940	187	161	169063	166480	751	738
Henderson	29612	27590	32	27	28803	28363	128	126
Hood	1593882	1485045	1715	1476	1550366	1526679	6886	6772
Hunt	0	0	0	0	0	0	0	0
Johnson	251056	233913	270	232	244201	240470	1085	1067
Kaufman	96560	89966	104	89	93924	92489	417	410
Nueces	3858533	3595057	4152	3572	3753188	3695845	16669	16395
Parker	0	0	0	0	0	0	0	0
Rockwall	307704	286693	331	285	299303	294730	1329	1307
Rusk	0	0	0	0	0	0	0	0
San Patricio	99135	92365	107	92	96428	94955	428	421
Smith	551035	513408	593	510	535991	527802	2381	2341
Travis	6929137	6455988	7456	6415	6739959	6636983	29934	29441
Upshur	0	0	0	0	0	0	0	0
Victoria	0	0	0	0	0	0	0	0
Williamson	1709754	1593005	1840	1583	1663074	1637665	7386	7265
Wilson	0	0	0	0	0	0	0	0

Table 22: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 Code-Compliant Retail and Food Service Building Types (Continued)

Other ERCOT Counties	Retail				Food Service			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
ANDERSON	0	0	0	0	0	0	0	0
ANDREWS	0	0	0	0	0	0	0	0
ANGELINA	30899	28789	33	29	30056	29596	133	131
ARANSAS	0	0	0	0	0	0	0	0
ARCHER	0	0	0	0	0	0	0	0
ATASCOSA	1506334	1403476	1621	1395	1465209	1442822	6507	6400
AUSTIN	0	0	0	0	0	0	0	0
BANDERA	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0
BEE	0	0	0	0	0	0	0	0
BELL	1758677	1638588	1892	1628	1710662	1684526	7598	7472
BLANCO	57936	53980	62	54	56354	55493	250	246
BORDEN	0	0	0	0	0	0	0	0
BOSQUE	0	0	0	0	0	0	0	0
BRAZOS	885776	825292	953	820	861593	848429	3827	3764
BREWSTER	0	0	0	0	0	0	0	0
BRISCOE	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0
BROWN	0	0	0	0	0	0	0	0
BURLESON	0	0	0	0	0	0	0	0
BURNET	178958	166738	193	166	174072	171412	773	760
CALHOUN	0	0	0	0	0	0	0	0
CALLAHAN	0	0	0	0	0	0	0	0
CAMERON	2338037	2178386	2516	2165	2274204	2239458	10100	9934
CHEROKEE	63086	58778	68	58	61363	60426	273	268
CHILDRESS	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	0	0
COLORADO	245906	229114	265	228	239192	235538	1062	1045
COMANCHE	0	0	0	0	0	0	0	0
CONCHO	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	0	0	0	0
CORYELL	0	0	0	0	0	0	0	0
COTTLE	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0
CROCKETT	0	0	0	0	0	0	0	0
CROSBY	0	0	0	0	0	0	0	0
CULBERSON	0	0	0	0	0	0	0	0
DAWSON	61798	57578	66	57	60111	59193	267	263
DE WITT	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0
ECTOR	205994	191928	222	191	200370	197309	890	875
EDWARDS	0	0	0	0	0	0	0	0
ERATH	0	0	0	0	0	0	0	0
FALLS	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0
FAYETTE	0	0	0	0	0	0	0	0
FISHER	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0
FREESTONE	0	0	0	0	0	0	0	0
FRIO	1287465	1199552	1385	1192	1252315	1233182	5562	5470
GILLESPIE	0	0	0	0	0	0	0	0
GLASSCOCK	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0
GONZALES	0	0	0	0	0	0	0	0
GRAYSON	66948	62377	72	62	65120	64125	289	284
GRIMES	0	0	0	0	0	0	0	0
HALL	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0
HIDALGO	4588525	4275203	4938	4248	4463251	4395059	19823	19496
HILL	0	0	0	0	0	0	0	0
HOPKINS	109435	101962	118	101	106447	104820	473	465
HOUSTON	0	0	0	0	0	0	0	0
HOWARD	0	0	0	0	0	0	0	0
HUDSPETH	0	0	0	0	0	0	0	0
IRION	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0
JACKSON	0	0	0	0	0	0	0	0
JEFF DAVIS	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0

Table 22: Energy Use of ASHRAE Standard 90.1-2004 and 90.1-2007 Code-Compliant Retail and Food Service Building Types (Continued)

Other ERCOT Counties	Retail				Food Service			
	Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE		Electricity (kWh/yr), DOE		Gas (mBtu/yr), DOE	
	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)	2004 (Annual)	2007 (Annual)
JIM WELLS	0	0	0	0	0	0	0	0
JONES	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0
KENDALL	1555258	1449059	1674	1440	1512796	1489683	6719	6608
KENEDY	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0
KERR	119734	111558	129	111	116465	114686	517	509
KIMBLE	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0
KLEBERG	0	0	0	0	0	0	0	0
KNOX	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0
LAMAR	0	0	0	0	0	0	0	0
LAMPASAS	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0
LEE	0	0	0	0	0	0	0	0
LEON	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	0	0
LLANO	0	0	0	0	0	0	0	0
LOVING	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0
MARTIN	0	0	0	0	0	0	0	0
MASON	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0
MAVERICK	61798	57578	66	57	60111	59193	267	263
MCCULLOCH	38624	35987	42	36	37569	36995	167	164
MCLENNAN	93985	87567	101	87	91419	90022	406	399
MCMULLEN	0	0	0	0	0	0	0	0
MEDINA	0	0	0	0	0	0	0	0
MENARD	0	0	0	0	0	0	0	0
MIDLAND	220157	205123	237	204	214146	210874	951	935
MILAM	0	0	0	0	0	0	0	0
MILLS	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	0	0
MOTLEY	0	0	0	0	0	0	0	0
NACOGDOCHES	0	0	0	0	0	0	0	0
NAVARRO	57936	53980	62	54	56354	55493	250	246
NOLAN	0	0	0	0	0	0	0	0
PALO PINTO	73386	68374	79	68	71382	70291	317	312
PECOS	0	0	0	0	0	0	0	0
PRESIDIO	0	0	0	0	0	0	0	0
RAINS	0	0	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0
REEVES	0	0	0	0	0	0	0	0
REFUGIO	0	0	0	0	0	0	0	0
ROBERTSON	0	0	0	0	0	0	0	0
RUNNELS	0	0	0	0	0	0	0	0
SAN SABA	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	0	0	0	0	0	0
SCURRY	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0
SOMERVELL	0	0	0	0	0	0	0	0
STARR	61798	57578	66	57	60111	59193	267	263
STEPHENS	0	0	0	0	0	0	0	0
STERLING	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0
TAYLOR	242043	225516	260	224	235435	231838	1046	1028
TERRELL	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0
TOM GREEN	140334	130751	151	130	136502	134417	606	596
UPTON	0	0	0	0	0	0	0	0
UVALDE	180245	167937	194	167	175324	172645	779	766
VAL VERDE	0	0	0	0	0	0	0	0
VAN ZANDT	0	0	0	0	0	0	0	0
WARD	0	0	0	0	0	0	0	0
WASHINGTON	0	0	0	0	0	0	0	0
WEBB	2559481	2384709	2754	2370	2489602	2451565	11057	10875
WHARTON	0	0	0	0	0	0	0	0
WICHITA	1022247	952444	1100	946	994338	979146	4416	4343
WILBARGER	0	0	0	0	0	0	0	0
WILLACY	0	0	0	0	0	0	0	0
WINKLER	105572	98363	114	98	102690	101121	456	449
WISE	191832	178733	206	178	186595	183744	829	815
YOUNG	0	0	0	0	0	0	0	0
ZAPATA	0	0	0	0	0	0	0	0
ZAVALA	0	0	0	0	0	0	0	0
Total	122467538	114104975	131783	113386	119123957	117303926	529069	520355

Table 22: Calculated the ASHRAE Standard 90.1-2004 and 2007 Annual Electricity and Natural Gas Savings. A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+)

Counties	Apartments		Healthcare		Lodging		Office		Education		Retail		Food Service		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
Non-attainment Counties																		
(square feet in thousands)																		
Brazoria	0	0	-32135	-71	0	0	-29209	-56	-49869	-3907	-19165	-42	-4171	-20	-134550	-4096	144	43827
Chambers	0	0	0	0	0	0	0	0	-5662	-444	-9319	-21	-2028	-10	-17009	-474	18	5069
Collin	-275803	-1479	-250879	-554	-12661	-241	-124410	-240	-378695	-29666	-384356	-846	-83651	-401	-1510456	-33426	1616	357656
Dallas	-998075	-5352	-1098353	-2425	0	0	-74282	-143	-466335	-36531	-1057156	-2326	-230080	-1102	-3924280	-47878	4199	512300
Denton	-489959	-2627	-155594	-344	0	0	-12313	-24	-62424	-4890	-138991	-306	-30250	-145	-889532	-8335	952	89186
El Paso	-203262	-1090	-71370	-158	-14665	-279	-29502	-57	-46458	-3639	-377060	-830	-82063	-393	-824380	-6446	882	68967
Fort Bend	-8370	-45	-84598	-187	0	0	-16178	-31	-414285	-32454	-382158	-841	-83173	-398	-988763	-33956	1058	363326
Galveston	-17027	-91	-28996	-64	-23071	-440	-1910	-4	-14665	-1149	-383126	-843	-83384	-399	-552179	-2989	591	31987
Hardin	0	0	0	0	0	0	-764	-1	0	0	0	0	0	0	-764	-1	1	16
Harris	-1177724	-6315	-611616	-1350	-39793	-758	-272434	-525	-1451476	-113704	-1437820	-3163	-312928	-1498	-5303791	-127315	5675	1362265
Jefferson	-22566	-121	-3139	-7	0	0	-2112	-4	-10164	-796	-34462	-76	-7500	-36	-79943	-1040	86	11127
Liberty	0	0	-4708	-10	0	0	0	0	0	0	0	0	0	0	-4708	-10	5	111
Montgomery	-119028	-638	-151634	-335	0	0	-484854	-935	-180626	-14150	-202200	-445	-44007	-211	-1182348	-16713	1265	178832
Orange	-16412	-88	0	0	0	0	0	0	0	0	0	0	0	0	-16412	-88	18	942
Tarrant	-316710	-1698	-470819	-1040	-33305	-634	-36557	-71	-189347	-14833	-457412	-1006	-99551	-477	-1603702	-19759	1716	211416
Waller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Affected Counties																		
(square feet in thousands)																		
Bastrop	0	0	0	0	0	0	-1258	-2	-1688	-132	-13011	-29	-2832	-14	-18789	-177	20	1892
Bexar	-743381	-3986	-1687026	-3725	-9619	-183	-242820	-468	-433734	-33977	-566424	-1246	-123277	-590	-3806281	-44176	4073	472683
Caldwell	0	0	0	0	0	0	0	0	0	0	-140661	-309	-30614	-147	-171275	-456	183	4879
Comal	-46569	-250	-13900	-31	-12063	-230	-2022	-4	-68227	-5345	-99518	-219	-21659	-104	-263958	-6181	282	66141
Ellis	0	0	-1943	-4	0	0	-1977	-4	-5029	-394	-140573	-309	-30594	-146	-180117	-858	193	9179
Gregg	0	0	0	0	0	0	-292	-1	-4220	-331	-6330	-14	-1378	-7	-12220	-352	13	3763
Guadalupe	-36106	-194	0	0	0	0	0	0	-20046	-1570	-3341	-7	-727	-3	-60220	-1775	64	18990
Harrison	0	0	-14199	-31	0	0	0	0	-352	-28	-71034	-156	-15460	-74	-101045	-289	108	3094
Hays	-13007	-70	0	0	-6049	-115	-13436	-26	-19624	-1537	-11868	-26	-2583	-12	-66567	-1787	71	19117
Henderson	0	0	-7473	-17	0	0	0	0	-43539	-3411	-2022	-4	-440	-2	-53474	-3434	57	36741
Hood	0	0	0	0	0	0	0	0	0	0	-108836	-239	-23687	-113	-132524	-353	142	3775
Hunt	0	0	0	0	0	0	-4494	-9	-703	-55	0	0	0	0	-5197	-64	6	682
Johnson	-39184	-210	0	0	0	0	-9414	-18	-1758	-138	-17143	-38	-3731	-18	-71231	-422	76	4511
Kaufman	0	0	0	0	0	0	0	0	-23071	-1807	-6593	-15	-1435	-7	-31099	-1829	33	19567
Nueces	-46138	-247	-72267	-160	0	0	-15121	-29	-124391	-9744	-263476	-580	-57343	-275	-578736	-11035	619	118072
Parker	-15243	-82	-21897	-48	0	0	-1685	-3	-14278	-1119	0	0	0	0	-53103	-1252	57	13395
Rockwall	0	0	-18982	-42	0	0	-1011	-2	0	0	-21011	-46	-4573	-22	-45577	-112	49	1198
Rusk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
San Patricio	0	0	0	0	0	0	0	0	-3517	-276	-6769	-15	-1473	-7	-11759	-297	13	3183
Smith	-50590	-271	-130783	-289	0	0	-8111	-16	-31124	-2438	-37627	-83	-8189	-39	-266424	-3136	285	33553
Travis	-738683	-3961	-347733	-768	-69212	-1319	-76057	-147	-153300	-12009	-473149	-1041	-102976	-493	-1961110	-19737	2098	211183
Upshur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Victoria	-20515	-110	-24811	-55	0	0	-1123	-2	0	0	0	0	0	0	-46450	-167	50	1786
Williamson	0	0	-178239	-394	0	0	-8808	-17	-403946	-31644	-116749	-257	-25409	-122	-733150	-32433	784	347032
Wilson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 23: Calculated the ASHRAE Standard 90.1-2004 and 2007 Annual Electricity and Natural Gas Savings. A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+) (Continued)

Counties	Apartments		Healthcare		Lodging		Office		Education		Retail		Food Service		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
Other ERCOT Counties																		
(square feet in thousands)																		
ANDERSON	0	0	0	0	0	0	-315	-1	0	0	0	0	0	0	-315	-1	0	6
ANDREWS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ANGELINA	-16412	-88	-59039	-130	0	0	-674	-1	-914	-72	-2110	-5	-459	-2	-79609	-298	85	3190
ARANSAS	0	0	0	0	0	0	-5168	-10	0	0	0	0	0	0	-5168	-10	6	107
ARCHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ATASCOSA	0	0	0	0	0	0	-157	0	-22156	-1736	-102858	-226	-22386	-107	-147558	-2069	158	22143
AUSTIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BANDERA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BAYLOR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEE	0	0	0	0	0	0	0	0	-14067	-1102	0	0	0	0	-14067	-1102	15	11791
BELL	-44682	-240	-969289	-2140	0	0	-5887	-11	-53210	-4168	-120089	-264	-26136	-125	-1219293	-6949	1305	74350
BLANCO	0	0	0	0	0	0	0	0	0	0	-3956	-9	-861	-4	-4817	-13	5	137
BORDEN	0	0	0	0	0	0	0	0	-41499	-3251	0	0	0	0	-41499	-3251	44	34785
BOSQUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BRAZOS	-81486	-437	-254093	-561	0	0	-4651	-9	-48357	-3788	-60484	-133	-13164	-63	-462234	-4991	495	53405
BREWSTER	0	0	0	0	-7737	-147	0	0	0	0	0	0	0	0	-7737	-147	8	1577
BRISCOE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROOKS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BROWN	0	0	0	0	0	0	0	0	-12485	-978	0	0	0	0	-12485	-978	13	10465
BURLESON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BURNET	0	0	0	0	0	0	0	0	0	0	-12220	-27	-2660	-13	-14879	-40	16	424
CALHOUN	0	0	0	0	0	0	-1685	-3	0	0	0	0	0	0	-1685	-3	2	35
CALLAHAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAMERON	-47123	-253	-1196	-3	0	0	-449	-1	-130932	-10257	-159650	-351	-34746	-166	-374097	-11031	400	118028
CHEROKEE	0	0	-7473	-17	0	0	0	0	-61721	-4835	-4308	-9	-938	-4	-74439	-4865	80	52061
CHILDRESS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLAY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COKE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLEMAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLORADO	0	0	-7623	-17	0	0	0	0	0	0	-16791	-37	-3654	-17	-28069	-71	30	763
COMANCHE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CONCHO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COOKE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CORYELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COTTLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CRANE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROCKETT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CROSBY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CULBERSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DAWSON	0	0	0	0	0	0	-4718	-9	-1794	-141	-4220	-9	-918	-4	-11650	-163	12	1747
DE WITT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DELTA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DICKENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIMMIT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DUVAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EASTLAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ECTOR	-13417	-72	0	0	0	0	-1416	-3	-10551	-827	-14066	-31	-3061	-15	-42510	-947	45	10130
EDWARDS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ERATH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FALLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FANNIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FAYETTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FISHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FOARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRANKLIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 23: Calculated the ASHRAE Standard 90.1-2004 and 2007 Annual Electricity and Natural Gas Savings. A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+) (Continued)

Counties	Apartments		Healthcare		Lodging		Office		Education		Retail		Food Service		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
Other ERCOT Counties																		
(square feet in thousands)																		
FREESTONE	0	0	0	0	0	0	0	0	-12098	-948	0	0	0	0	-12098	-948	13	10141
FRIO	0	0	0	0	-6858	-131	0	0	0	0	-87913	-193	-19133	-92	-113904	-416	122	4448
GILLESPIE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GLASSCOCK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GOLIAD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GONZALES	0	0	0	0	0	0	0	0	-3517	-276	0	0	0	0	-3517	-276	4	2948
GRAYSON	-25644	-138	-8744	-19	0	0	0	0	-41851	-3278	-4571	-10	-995	-5	-81805	-3450	88	36916
GRIMES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HAMILTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HARDEMAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HASKELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HIDALGO	-5478	-29	-61954	-137	-30421	-580	-9617	-19	-427474	-33487	-313322	-689	-68192	-327	-916456	-35267	981	377358
HILL	0	0	0	0	0	0	0	0	-24583	-1926	0	0	0	0	-24583	-1926	26	20605
HOPKINS	0	0	-11584	-26	0	0	0	0	-4396	-344	-7473	-16	-1626	-8	-25079	-394	27	4218
HOUSTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HOWARD	0	0	-822	-2	0	0	0	0	-21101	-1653	0	0	0	0	-21923	-1655	23	17707
HUDSPETH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IRION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JACK	0	0	0	0	0	0	0	0	-14630	-1146	0	0	0	0	-14630	-1146	16	12263
JACKSON	0	0	0	0	0	0	-764	-1	-30386	-2380	0	0	0	0	-31150	-2382	33	25485
JEFF DAVIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JIM HOGG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
JIM WELLS	0	0	0	0	0	0	-449	-1	-23598	-1849	0	0	0	0	-24047	-1849	26	19789
JONES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KARNES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KENDALL	-10257	-55	0	0	0	0	-3550	-7	0	0	-106199	-234	-23113	-111	-143120	-406	153	4346
KENEDY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KERR	0	0	-29893	-66	0	0	0	0	0	0	-8176	-18	-1779	-9	-39849	-93	43	990
KIMBLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KINNEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KLEBERG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KNOX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LA SALLE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAMAR	0	0	-23167	-51	0	0	0	0	-14700	-1152	0	0	0	0	-37868	-1203	41	12869
LAMPASAS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAVACA	0	0	0	0	0	0	0	0	-24266	-1901	0	0	0	0	-24266	-1901	26	20340
LEE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LEON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIMESTONE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LIVE OAK	0	0	0	0	0	0	-607	-1	-20398	-1598	0	0	0	0	-21004	-1599	22	17110
LLANO	0	0	-6726	-15	0	0	0	0	0	0	0	0	0	0	-6726	-15	7	159
LOVING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MADISON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MARTIN	0	0	-45737	-101	0	0	0	0	0	0	0	0	0	0	-45737	-101	49	1080
MASON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MATAGORDA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAVERICK	0	0	0	0	-8651	-165	0	0	0	0	-4220	-9	-918	-4	-13790	-179	15	1910
MCCULLOCH	0	0	0	0	0	0	0	0	0	0	-2637	-6	-574	-3	-3211	-9	3	91
MCLENNAN	0	0	-44840	-99	0	0	-5685	-11	-124039	-9717	-6418	-14	-1397	-7	-182378	-9848	195	105370
MCMULLEN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MEDINA	0	0	0	0	0	0	-854	-2	0	0	0	0	0	0	-854	-2	1	18
MENARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MIDLAND	-23900	-128	-35199	-78	-10937	-208	-28490	-55	-28803	-2256	-15033	-33	-3272	-16	-145635	-2774	156	29685
MILAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MILLS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MITCHELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MONTAGUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MOTLEY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 23: Calculated the ASHRAE Standard 90.1-2004 and 2007 Annual Electricity and Natural Gas Savings. A decrease in energy use is negative (i.e., savings); a positive value represents an energy use increase (+) (Continued)

Counties	Apartments		Healthcare		Lodging		Office		Education		Retail		Food Service		Total		Total*1.07 (T&D loss) for eGrid	
	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	kWh/yr	mBtu/yr	MWh/yr	Therm/yr
Other ERCOT Counties																		
(square feet in thousands)																		
NACOGDOCHES	-41851	-224	0	0	0	0	-989	-2	-2567	-201	0	0	0	0	-45406	-427	49	4573
NAVARRO	0	0	-7174	-16	0	0	0	0	0	0	-3956	-9	-861	-4	-11991	-29	13	307
NOLAN	0	0	0	0	0	0	0	0	-9496	-744	0	0	0	0	-9496	-744	10	7959
PALO PINTO	0	0	0	0	0	0	0	0	0	0	-5011	-11	-1091	-5	-6102	-16	7	174
PECOS	0	0	0	0	0	0	0	0	-2813	-220	0	0	0	0	-2813	-220	3	2358
PRESIDIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RAINS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REAGAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RED RIVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REEVES	0	0	0	0	0	0	0	0	-3517	-276	0	0	0	0	-3517	-276	4	2948
REFUGIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ROBERTSON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RUNNELS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAN SABA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SCHLEICHER	0	0	-43943	-97	0	0	0	0	0	0	0	0	0	0	-43943	-97	47	1038
SCURRY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SHACKELFORD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOMERVELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STARR	0	0	0	0	0	0	0	0	0	0	-4220	-9	-918	-4	-5138	-14	5	146
STEPHENS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STERLING	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
STONEWALL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUTTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TAYLOR	0	0	0	0	0	0	-3820	-7	-44242	-3466	-16528	-36	-3597	-17	-68186	-3527	73	37736
TERRELL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
THROCKMORTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TITUS	0	0	0	0	0	0	0	0	-6682	-523	0	0	0	0	-6682	-523	7	5601
TOM GREEN	0	0	-13527	-30	0	0	-3191	-6	-1055	-83	-9583	-21	-2086	-10	-29440	-150	32	1602
UPTON	0	0	0	0	0	0	0	0	-14771	-1157	0	0	0	0	-14771	-1157	16	12381
UVALDE	0	0	0	0	0	0	0	0	0	0	-12308	-27	-2679	-13	-14987	-40	16	427
VAL VERDE	-12350	-66	0	0	0	0	-1438	-3	-5732	-449	0	0	0	0	-19520	-518	21	5543
VAN ZANDT	0	0	0	0	0	0	0	0	-19870	-1557	0	0	0	0	-19870	-1557	21	16655
WARD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WASHINGTON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WEBB	-27326	-147	-31836	-70	0	0	-899	-2	-20996	-1645	-174771	-384	-38037	-182	-293865	-2430	314	26000
WHARTON	0	0	0	0	0	0	-1258	-2	0	0	0	0	0	0	-1258	-2	1	26
WICHITA	-6893	-37	-11584	-26	-229	-4	-1326	-3	0	0	-69803	-154	-15192	-73	-105026	-296	112	3165
WILBARGER	0	0	0	0	0	0	0	0	-246	-19	0	0	0	0	-246	-19	0	206
WILLACY	0	0	0	0	0	0	0	0	-6119	-479	0	0	0	0	-6119	-479	7	5129
WINKLER	0	0	0	0	0	0	0	0	0	0	-7209	-16	-1569	-8	-8778	-23	9	250
WISE	0	0	0	0	0	0	-404	-1	-35098	-2749	-13099	-29	-2851	-14	-51453	-2793	55	29882
YOUNG	0	0	0	0	0	0	0	0	-1336	-105	0	0	0	0	-1336	-105	1	1120
ZAPATA	0	0	0	0	0	0	-2224	-4	0	0	0	0	0	0	-2224	-4	2	46
ZAVALA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	-5751171	-30837	-7158540	-15805	-285270	-5435	-1562839	-3014	-6010621	-470854	-8362563	-18397	-1820031	-8714	-30951035	-553057	33118	5917709

Table 19: Totalized Annual Electricity Savings from the ASHRAE Standard 90.1-2007 by CM Zones for Commercial Buildings

CM Zones	Total Electricity Savings by CM Zones (MWh) 2012-TRY 2008
H	9,722.11
N	8,164.58
W	720.32
S	8,031.49
Total	26,638.50

Table 24: 2012 Annual NOx Reductions from the ASHRAE Standard 90.1-2007 by CM Zones for Commercial Buildings by County using 2010 eGRID

Area	County	H	NOx Reductions (lbs)	N	NOx Reductions (lbs)	W	NOx Reductions (lbs/year)	S	NOx Reductions (lbs)	Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
Houston-Galveston Area	Brazoria	0.0562032	546.4136437	0.0000071	0.0582180	0.0000003	0.0002481	0.0005265	4.2289163	550.7010260	0.2753505
	Chambers	0.0204500	198.8171935	0.0000026	0.0211831	0.0000001	0.0000903	0.0001916	1.5387267	200.3771936	0.1001886
	Fort Bend	0.0313463	304.7523829	0.0000040	0.0324700	0.0000002	0.0001384	0.0002937	2.3586020	307.1435933	0.1535718
	Galveston	0.0226620	220.3221149	0.0000029	0.0234744	0.0000001	0.0001000	0.0002123	1.7051620	222.0508513	0.1110254
	Harris	0.1486911	1445.5913831	0.0000189	0.1540214	0.0000009	0.0006563	0.0013930	11.1880168	1456.9340776	0.7284670
Dallas/ Fort Worth Area	Collin	0.0012932	12.5723214	0.0079329	64.7690418	0.0003832	0.2760074	0.0000809	0.6500259	78.2673965	0.0391337
	Dallas	0.0024826	24.1361909	0.0152295	124.3428244	0.0007356	0.5298757	0.0001554	1.2479119	150.2568028	0.0751284
	Denton	0.0001267	1.2314368	0.0007770	6.3440140	0.0000375	0.0270344	0.0000079	0.0636689	7.6661542	0.0038331
	Tarrant	0.0004742	4.6100559	0.0029089	23.7497033	0.0001405	0.1012072	0.0000297	0.2383534	28.6993198	0.0143497
	Ellis	0.0029920	29.0884759	0.0183544	149.8555956	0.0008865	0.6385960	0.0001873	1.5039596	181.0866271	0.0905433
	Johnson	0.0007256	7.0543524	0.0044512	36.3420271	0.0002150	0.1548682	0.0000454	0.3647307	43.9159784	0.0219580
	Kaufman	0.0059718	58.0589641	0.0366343	299.1033517	0.0017695	1.2746018	0.0003738	3.0018188	361.4387365	0.1807194
	Parker	0.0000012	0.0119535	0.0000075	0.0615812	0.0000004	0.0002624	0.0000001	0.0006180	0.0744152	0.0000372
	Henderson	0.0006908	6.7158022	0.0042376	34.5979120	0.0002047	0.1474359	0.0000432	0.3472267	41.8083767	0.0209042
	Hood	0.0050771	49.3600792	0.0311454	254.2891581	0.0015044	1.0836302	0.0003178	2.5520609	307.2849284	0.1536425
	Hunt	0.0088463	86.0050455	0.0047066	38.4277210	0.0002273	0.1637562	0.0652823	524.3139639	648.9104867	0.3244552
San Antonio Area	Bexar	0.0138906	135.0459832	0.0009368	7.6486931	0.0000452	0.0325942	0.1109355	890.9774568	1033.7047273	0.5168524
	Guadalupe	0.0032029	31.1388393	0.0002160	1.7636321	0.0000104	0.0075156	0.0255795	205.4411630	238.3511500	0.1191756
Austin Area	Bastrop	0.0033782	32.8434634	0.0002278	1.8601780	0.0000110	0.0079270	0.0269798	216.6875666	251.3991350	0.1256996
	Hays	0.0008331	8.0997700	0.0000562	0.4587523	0.0000027	0.0019549	0.0066537	53.4389271	61.9994043	0.0309997
	Travis	0.0051785	50.3462864	0.0003493	2.8514976	0.0000169	0.0121514	0.0413577	332.1639424	385.3738777	0.1926869
	Rusk	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Corpus Christi Area	Nueces	0.0128578	125.0047313	0.0008672	7.0799797	0.0000419	0.0301707	0.1026870	824.7294360	956.8443176	0.4784222
	San Patricio	0.0015100	14.6799345	0.0001018	0.8314376	0.0000049	0.0035431	0.0120591	96.8521268	112.3670420	0.0561835
Victoria Area	Victoria	0.0021192	20.6026646	0.0001429	1.1668874	0.0000069	0.0049726	0.0169244	135.9278465	157.7023710	0.0788512
Other ERCOT counties	Andrews	0.0000037	0.0364020	0.0000230	0.1875326	0.0039003	2.8094427	0.0000002	0.0018821	3.0352594	0.0015176
	Bosque	0.0022204	21.5872062	0.0136212	111.2111768	0.0006579	0.4739163	0.0001390	1.1161219	134.3884212	0.0671942
	Brazos	0.0024089	23.4193694	0.0112305	91.6924703	0.0005425	0.3907391	0.0047829	38.4138737	153.9164525	0.0769582
	Calhoun	0.0009466	9.2027818	0.0000638	0.5212243	0.0000031	0.0022212	0.0075598	60.7161422	70.4423695	0.0352212
	Cameron	0.0063536	61.7706921	0.0004285	3.4985496	0.0000207	0.0149088	0.0507425	407.5374393	472.8215897	0.2364108
	Cherokee	0.0027392	26.6303674	0.0168033	137.1921160	0.0008116	0.5846317	0.0001714	1.3768681	165.7839833	0.0828920
	Coke	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Ector	0.0019215	18.6811150	0.0006604	5.3915222	0.0911346	65.6460254	0.0146527	117.6828543	207.4015170	0.1037008
	Fannin	0.0000041	0.0394223	0.0000249	0.2030927	0.0000012	0.0008655	0.0000003	0.0020383	0.2454188	0.0001227
	Fayette	0.0051867	50.4256869	0.0103217	84.2721735	0.0004986	0.3591182	0.0283993	228.0886830	363.1456616	0.1815728
	Freestone	0.0047643	46.3194235	0.0292268	238.6245608	0.0014117	1.0168769	0.0002982	2.3948501	288.3557113	0.1441779
	Frio	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Grimes	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Hidalgo	0.0053716	52.2230453	0.0003623	2.9577929	0.0000175	0.0126044	0.0428994	344.5460205	399.7394631	0.1998697
	Howard	0.0002411	2.3441734	0.0007641	6.2383140	0.1283942	92.4847740	0.0009490	7.6218102	108.6890716	0.0543445
	Jack	0.0030783	29.9276995	0.0188839	154.1790381	0.0009121	0.6570200	0.0001927	1.5473499	186.3111075	0.0931556
	Lamar	0.0040001	38.8898164	0.0245388	200.3493278	0.0011853	0.8537705	0.0002504	2.0107176	242.1036323	0.1210518
	Limestone	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Llano	0.0040314	39.1941734	0.0002719	2.2198676	0.0000131	0.0094598	0.0321966	258.5869204	300.0104212	0.1500052
	McLennan	0.0056576	55.0040234	0.0347066	283.3651614	0.0016764	1.2075349	0.0003541	2.8438694	342.4205891	0.1712103
	Milam	0.0012686	12.3335288	0.0000856	0.6985426	0.0000041	0.0029768	0.0101316	81.3715138	94.4065619	0.0472033
	Mitchell	0.0000311	0.3026373	0.0001910	1.5591018	0.0324260	23.3570453	0.0000019	0.0156472	25.2344316	0.0126172
	Nolan	0.0000293	0.2844237	0.0001795	1.4652705	0.0304745	21.9513501	0.0000018	0.0147055	23.7157499	0.0118579
	Palo Pinto	0.0036129	35.1253839	0.0221635	180.9560370	0.0010705	0.7711277	0.0002261	1.8160854	218.6686341	0.1093343
	Pecos	0.0000020	0.0191520	0.0000121	0.0986655	0.0020520	1.4781166	0.0000001	0.0009902	1.5969243	0.0007985
	Robertson	0.0039506	38.4079127	0.0055755	45.5214115	0.0002693	0.1939854	0.0246170	197.7107997	281.8341093	0.1409171
	Titus	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
	Upton	0.0000025	0.0247276	0.0000156	0.1273896	0.0026494	1.9084350	0.0000002	0.0012785	2.0618307	0.0010309
	Ward	0.0001995	1.9397472	0.0012239	9.9930288	0.2078335	149.7064693	0.0000125	0.1002906	161.7395360	0.0808698
	Webb	0.0042017	40.8496408	0.0002834	2.3136295	0.0000137	0.0098593	0.0335565	269.5090086	312.6821382	0.1563411
	Wharton	0.0021095	20.5089175	0.0001423	1.1615778	0.0000069	0.0049500	0.0168474	135.3093425	156.9847878	0.0784924
	Wichita	0.0000121	0.1177752	0.0000743	0.6067447	0.0126190	9.0896979	0.0000008	0.0060893	9.8203072	0.0049102
	Wilbarger	0.0179710	174.7161117	0.1102430	900.0879602	0.0053249	3.8356431	0.0011247	9.0333357	1087.6730507	0.5438365
	Wise	0.0010202	9.9183071	0.0062583	51.0963111	0.0003023	0.2177423	0.0000638	0.5128056	61.7451661	0.0308726
	Young	0.0071054	69.0794883	0.0435880	355.8779731	0.0021054	1.5165417	0.0004447	3.5716123	430.0456153	0.2150228
	Total	**0.4414501**	**4291.82622**	**0.4812863**	**3929.500919**	**0.5345786**	**385.0671877**	**0.6829349**	**5484.983174**	**14091.3775012**	**7.0456888**

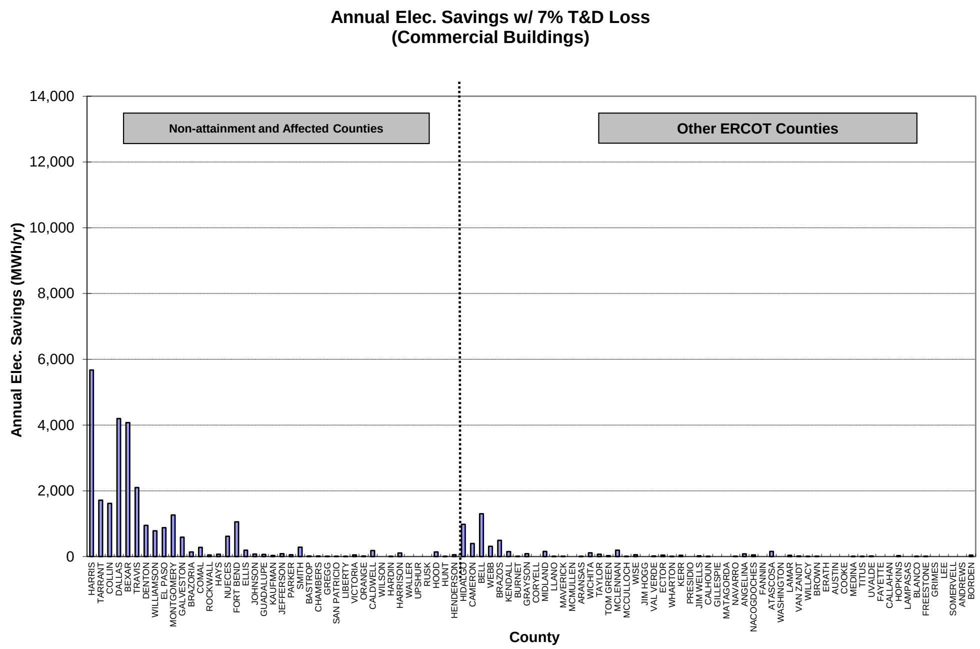
Energy Savings by PCA (MWh)		9,722.11		8,164.58		720.32		8,031.49	

Table 25: 2012 Annual NOx Reductions from the ASHRAE Standard 90.1-2007 for Commercial Buildings by County using 2010 eGRID (w/7% T&D)

	Electricity Savings and Resultant NOx Reductions (Commercial)		Total Natural Gas Savings and Resultant NOx Reductions (Commercial)		Total Nox Reductions
County	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
HARRIS	5,675.06	0.73	1,362,265.42	6.27	6.99
TARRANT	1,715.96	0.01	211,416.18	0.97	0.99
COLLIN	1,616.19	0.04	357,656.09	1.65	1.68
DALLAS	4,198.98	0.08	512,299.61	2.36	2.43
BEXAR	4,072.72	0.52	472,682.97	2.17	2.69
TRAVIS	2,098.39	0.19	211,183.21	0.97	1.16
DENTON	951.80	0.00	89,185.99	0.41	0.41
WILLIAMSON	784.47		347,032.46	1.60	1.60
EL PASO	882.09		68,967.08	0.32	0.32
MONTGOMERY	1,265.11		178,832.39	0.82	0.82
GALVESTON	590.83	0.11	31,987.11	0.15	0.26
BRAZORIA	143.97	0.28	43,827.27	0.20	0.48
COMAL	282.44		66,141.36	0.30	0.30
ROCKWALL	48.77		1,198.17	0.01	0.01
HAYS	71.23	0.03	19,117.26	0.09	0.12
NUECES	619.25	0.48	118,071.61	0.54	1.02
FORT BEND	1,057.98	0.15	363,326.16	1.67	1.82
ELLIS	192.73	0.09	9,178.52	0.04	0.13
JOHNSON	76.22	0.02	4,510.95	0.02	0.04
GUADALUPE	64.44	0.12	18,990.15	0.09	0.21
KAUFMAN	33.28	0.18	19,566.62	0.09	0.27
JEFFERSON	85.54		11,127.18	0.05	0.05
PARKER	56.82	0.00	13,394.85	0.06	0.06
SMITH	285.07		33,553.21	0.15	0.15
BASTROP	20.10	0.13	1,892.28	0.01	0.13
CHAMBERS	18.20	0.10	5,069.30	0.02	0.12
GREGG	13.08		3,763.02	0.02	0.02
SAN PATRICIO	12.58	0.06	3,182.67	0.01	0.07
LIBERTY	5.04		111.23	0.00	0.00
VICTORIA	49.70	0.08	1,786.33	0.01	0.09
ORANGE	17.56		941.60	0.00	0.00
CALDWELL	183.26		4,879.44	0.02	0.02
WILSON	0.00		0.00	0.00	0.00
HARDIN	0.82		15.76	0.00	0.00
HARRISON	108.12		3,094.35	0.01	0.01
WALLER	0.00		0.00	0.00	0.00
UPSHUR	0.00		0.00	0.00	0.00
RUSK	0.00	0.00	0.00	0.00	0.00
HOOD	141.80	0.15	3,775.47	0.02	0.17
HUNT	5.56	0.32	682.30	0.00	0.33
HENDERSON	57.22	0.02	36,741.07	0.17	0.19
HIDALGO	980.61	0.20	377,357.61	1.74	1.94
CAMERON	400.28	0.24	118,027.71	0.54	0.78
BELL	1,304.64		74,350.31	0.34	0.34
WEBB	314.44	0.16	25,999.78	0.12	0.28
BRAZOS	494.59	0.08	53,404.82	0.25	0.32
KENDALL	153.14		4,345.74	0.02	0.02
BURNET	15.92		423.90	0.00	0.00
GRAYSON	87.53		36,915.81	0.17	0.17
CORYELL	0.00		0.00	0.00	0.00
MIDLAND	155.83		29,684.63	0.14	0.14
LLANO	7.20	0.15	158.90	0.00	0.15
MAVERICK	14.75		1,909.96	0.01	0.01
MCMULLEN	0.00		0.00	0.00	0.00
ARANSAS	5.53		106.64	0.00	0.00
WICHITA	112.38	0.00	3,164.50	0.01	0.02
TAYLOR	72.96		37,736.11	0.17	0.17
TOM GREEN	31.50		1,602.16	0.01	0.01
MCLENNAN	195.14	0.17	105,369.90	0.48	0.66
MCCULLOCH	3.44		91.49	0.00	0.00
WISE	55.05	0.03	29,882.29	0.14	0.17
JIM HOGG	0.00		0.00	0.00	0.00
VAL VERDE	20.89		5,543.22	0.03	0.03
ECTOR	45.49	0.10	10,130.46	0.05	0.15
WHARTON	1.35	0.08	25.97	0.00	0.08
KERR	42.64		989.82	0.00	0.00
PRESIDIO	0.00		0.00	0.00	0.00
JIM WELLS	25.73		19,789.35	0.09	0.09
CALHOUN	1.80	0.04	34.78	0.00	0.04
GILLESPIE	0.00		0.00	0.00	0.00
MATAGORDA	0.00		0.00	0.00	0.00
NAVARRO	12.83		306.72	0.00	0.00
ANGELINA	85.18		3,189.89	0.01	0.01
NACOGDOCHES	48.58		4,573.41	0.02	0.02
FANNIN	0.00	0.00	0.00	0.00	0.00
ATASCOSA	157.89		22,142.79	0.10	0.10
WASHINGTON	0.00		0.00	0.00	0.00
LAMAR	40.52	0.12	12,869.32	0.06	0.18
VAN ZANDT	21.26		16,655.35	0.08	0.08
WILLACY	6.55		5,129.26	0.02	0.02
BROWN	13.36		10,464.87	0.05	0.05
ERATH	0.00		0.00	0.00	0.00
AUSTIN	0.00		0.00	0.00	0.00
COOKE	0.00		0.00	0.00	0.00
MEDINA	0.91		17.62	0.00	0.00
TITUS	7.15	0.00	5,600.92	0.03	0.03
UVALDE	16.04		426.95	0.00	0.00
FAYETTE	0.00	0.18	0.00	0.00	0.18
CALLAHAN	0.00		0.00	0.00	0.00
HOPKINS	26.83		4,217.69	0.02	0.02
LAMPASAS	0.00		0.00	0.00	0.00
BLANCO	5.15		137.23	0.00	0.00
FREESTONE	12.94	0.14	10,140.60	0.05	0.19
GRIMES	0.00	0.00	0.00	0.00	0.00
LEE	0.00		0.00	0.00	0.00
SOMERVELL	0.00		0.00	0.00	0.00
ANDREWS	0.00	0.00	0.00	0.00	0.00
BORDEN	44.40		34,784.63	0.16	0.16

Table 26: 2012 Annual NOx Reductions from the ASHRAE Standard 90.1-2007 for Commercial Buildings by County using 2010 eGRID (w/7% T&D) (Continued)

	Electricity Savings and Resultant NOx Reductions (Commercial)		Total Natural Gas Savings and Resultant NOx Reductions (Commercial)		Total Nox Reductions
County	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
CHEROKEE	79.65	0.08	52,060.75	0.24	0.32
DIMMIT	0.00		0.00	0.00	0.00
FALLS	0.00		0.00	0.00	0.00
COLORADO	30.03		762.56	0.00	0.00
FRIO	121.88	0.00	4,447.60	0.02	0.02
MILAM	0.00	0.05	0.00	0.00	0.05
JACKSON	33.33		25,485.19	0.12	0.12
ANDERSON	0.34		6.49	0.00	0.00
HILL	26.30		20,605.47	0.09	0.09
CULBERSON	0.00		0.00	0.00	0.00
MASON	0.00		0.00	0.00	0.00
PECOS	3.01	0.00	2,358.28	0.01	0.01
RAINS	0.00		0.00	0.00	0.00
LAVACA	25.96		20,340.17	0.09	0.09
PALO PINTO	6.53	0.11	173.83	0.00	0.11
KIMBLE	0.00		0.00	0.00	0.00
MADISON	0.00		0.00	0.00	0.00
ARCHER	0.00		0.00	0.00	0.00
REFUGIO	0.00		0.00	0.00	0.00
LIMESTONE	0.00	0.00	0.00	0.00	0.00
CLAY	0.00		0.00	0.00	0.00
BEE	15.05		11,791.40	0.05	0.05
MARTIN	48.94		1,080.49	0.00	0.00
GONZALES	3.76		2,947.85	0.01	0.01
BURLESON	0.00		0.00	0.00	0.00
KARNES	0.00		0.00	0.00	0.00
KLEBERG	0.00		0.00	0.00	0.00
BREWSTER	8.28		1,577.18	0.01	0.01
WINKLER	9.39		250.07	0.00	0.00
FRANKLIN	0.00		0.00	0.00	0.00
YOUNG	1.43	0.22	1,120.18	0.01	0.22
HOUSTON	0.00		0.00	0.00	0.00
SCURRY	0.00		0.00	0.00	0.00
BOSQUE	0.00	0.07	0.00	0.00	0.07
COMANCHE	0.00		0.00	0.00	0.00
BRISCOE	0.00		0.00	0.00	0.00
CONCHO	0.00		0.00	0.00	0.00
ZAVALA	0.00		0.00	0.00	0.00
NOLAN	10.16	0.01	7,959.20	0.04	0.05
BROOKS	0.00		0.00	0.00	0.00
ROBERTSON	0.00	0.14	0.00	0.00	0.14
LIVE OAK	22.47		17,110.05	0.08	0.08
HAMILTON	0.00		0.00	0.00	0.00
JONES	0.00		0.00	0.00	0.00
REAGAN	0.00		0.00	0.00	0.00
WARD	0.00	0.08	0.00	0.00	0.08
RED RIVER	0.00		0.00	0.00	0.00
HASKELL	0.00		0.00	0.00	0.00
HOWARD	23.46	0.05	17,706.52	0.08	0.14
SAN SABA	0.00		0.00	0.00	0.00
JACK	15.65	0.09	12,263.06	0.06	0.15
STEPHENS	0.00		0.00	0.00	0.00
RUNNELS	0.00		0.00	0.00	0.00
REEVES	3.76		2,947.85	0.01	0.01
DE WITT	0.00		0.00	0.00	0.00
CHILDRESS	0.00		0.00	0.00	0.00
CROSBY	0.00		0.00	0.00	0.00
DAWSON	12.47		1,747.16	0.01	0.01
MITCHELL	0.00	0.01	0.00	0.00	0.01
WILBARGER	0.26	0.54	206.35	0.00	0.54
COLEMAN	0.00		0.00	0.00	0.00
UPTON	15.80	0.00	12,380.97	0.06	0.06
COKE	0.00	0.00	0.00	0.00	0.00
CROCKETT	0.00		0.00	0.00	0.00
HARDEMAN	0.00		0.00	0.00	0.00
BANDERA	0.00		0.00	0.00	0.00
BAYLOR	0.00		0.00	0.00	0.00
COTTLE	0.00		0.00	0.00	0.00
CRANE	0.00		0.00	0.00	0.00
DELTA	0.00		0.00	0.00	0.00
DICKENS	0.00		0.00	0.00	0.00
DUVAL	0.00		0.00	0.00	0.00
EASTLAND	0.00		0.00	0.00	0.00
EDWARDS	0.00		0.00	0.00	0.00
FISHER	0.00		0.00	0.00	0.00
FOARD	0.00		0.00	0.00	0.00
GLASSCOCK	0.00		0.00	0.00	0.00
GOLIAD	0.00		0.00	0.00	0.00
HALL	0.00		0.00	0.00	0.00
HUDSPETH	0.00		0.00	0.00	0.00
IRION	0.00		0.00	0.00	0.00
JEFF DAVIS	0.00		0.00	0.00	0.00
KENEDY	0.00		0.00	0.00	0.00
KENT	0.00		0.00	0.00	0.00
KING	0.00		0.00	0.00	0.00
KINNEY	0.00		0.00	0.00	0.00
KNOX	0.00		0.00	0.00	0.00
LA SALLE	0.00		0.00	0.00	0.00
LEON	0.00		0.00	0.00	0.00
LOVING	0.00		0.00	0.00	0.00
MENARD	0.00		0.00	0.00	0.00
MILLS	0.00		0.00	0.00	0.00
MONTAGUE	0.00		0.00	0.00	0.00
MOTLEY	0.00		0.00	0.00	0.00
REAL	0.00		0.00	0.00	0.00
SCHLEICHER	47.02		1,038.11	0.00	0.00
SHACKELFORD	0.00		0.00	0.00	0.00
STARR	5.50		146.38	0.00	0.00
STERLING	0.00		0.00	0.00	0.00
STONEWALL	0.00		0.00	0.00	0.00
SUTTON	0.00		0.00	0.00	0.00
TERRELL	0.00		0.00	0.00	0.00
THROCKMORTOI	0.00		0.00	0.00	0.00
ZAPATA	2.38		45.90	0.00	0.00
TOTAL	**33,117.61**	**7.05**	**5,917,708.83**	**27.22**	**34.27**



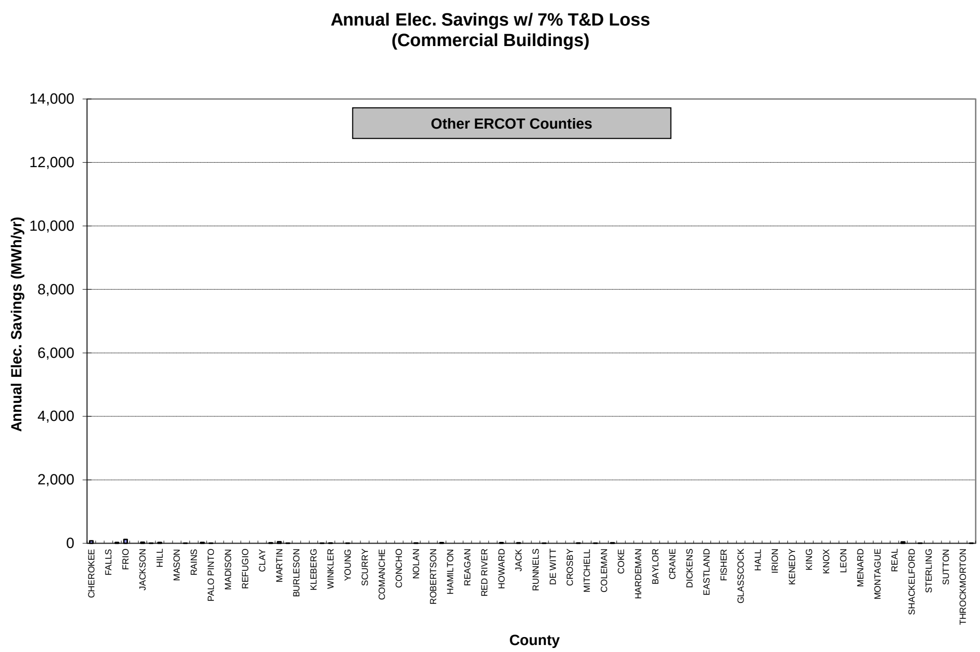
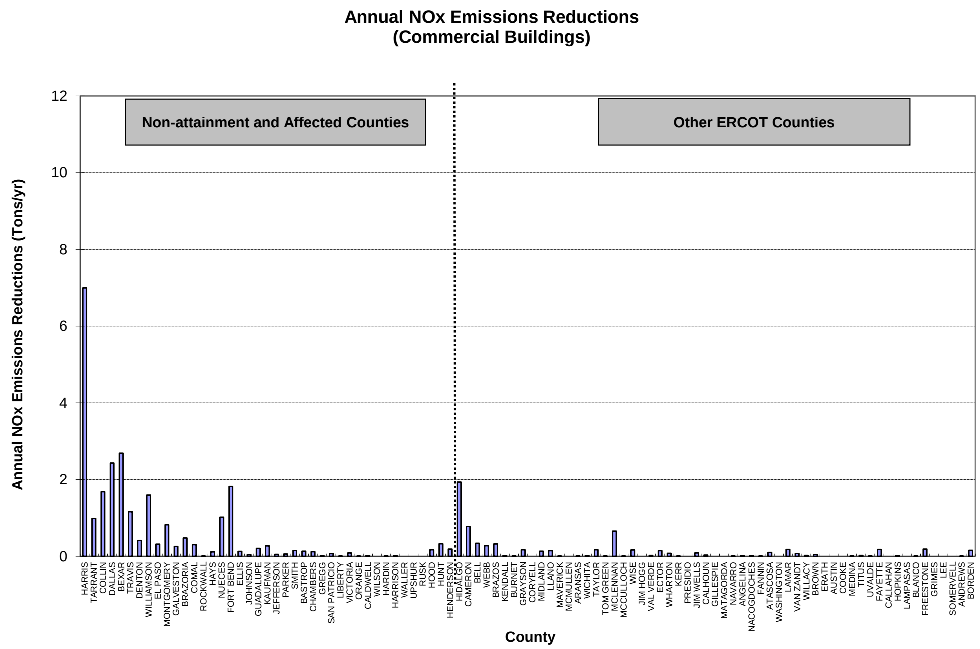


Figure 55: 2012 Annual Electricity Reductions from the ASHRAE Standard 90.1-2007 for Commercial Buildings with 7% T&D Losses



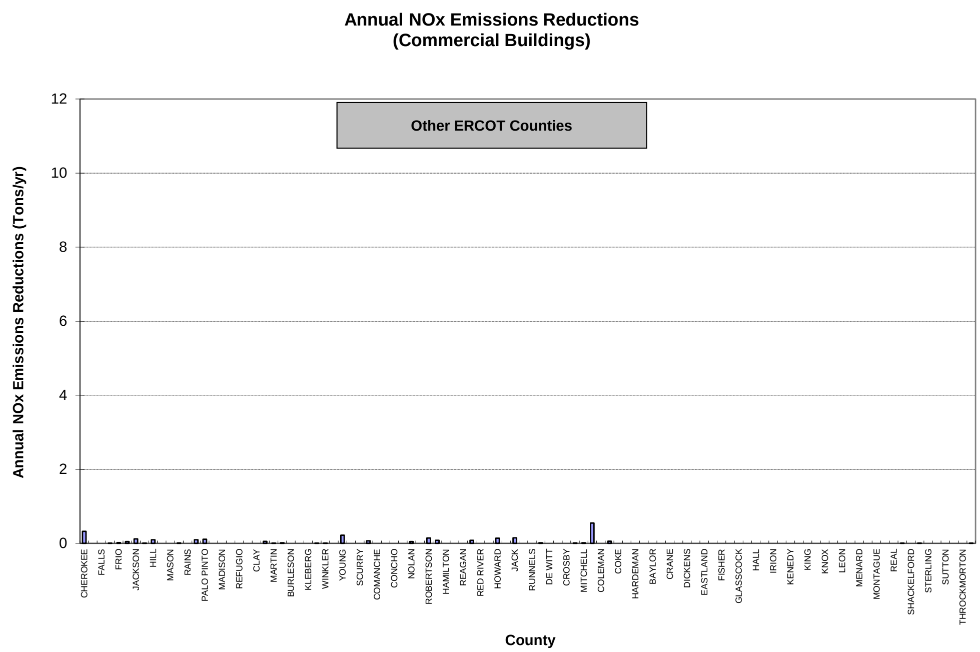


Figure 56: 2012 Annual NOx Reductions from Electricity Savings from the ASHRAE Standard 90.1-2007 for Commercial Buildings by County using 2010 eGRID with 7% T&D Losses

4.1.6 2012 Results for New Residential (Single-family and Multi-family) and Commercial Construction Using 2010 eGRID

Figure 57 shows the bar chart and **Error! Reference source not found.** shows the spatial distribution of the 2012 annual electricity savings, and **Error! Reference source not found.** shows the bar chart and **Error! Reference urce not found.** shows the spatial distribution of the 2012 annual NOx savings for new residential and commercial construction, respectively. As shown in Table 26, the total annual electricity savings in 2012 were calculated to be 228,300.71 MWh/yr which includes 75,591.15 MWh/yr (i.e., 33.11 %) for single-family residential, 119,591.95 MWh/yr (i.e., 52.38 %) for multi-family residential, and 33,117.61 MWh/yr (i.e., 14.51 %) for new commercial buildings. Natural gas savings were calculated to be 770,754.19 MMBtu (7,707,541.87 therms) for new residential and commercial construction.

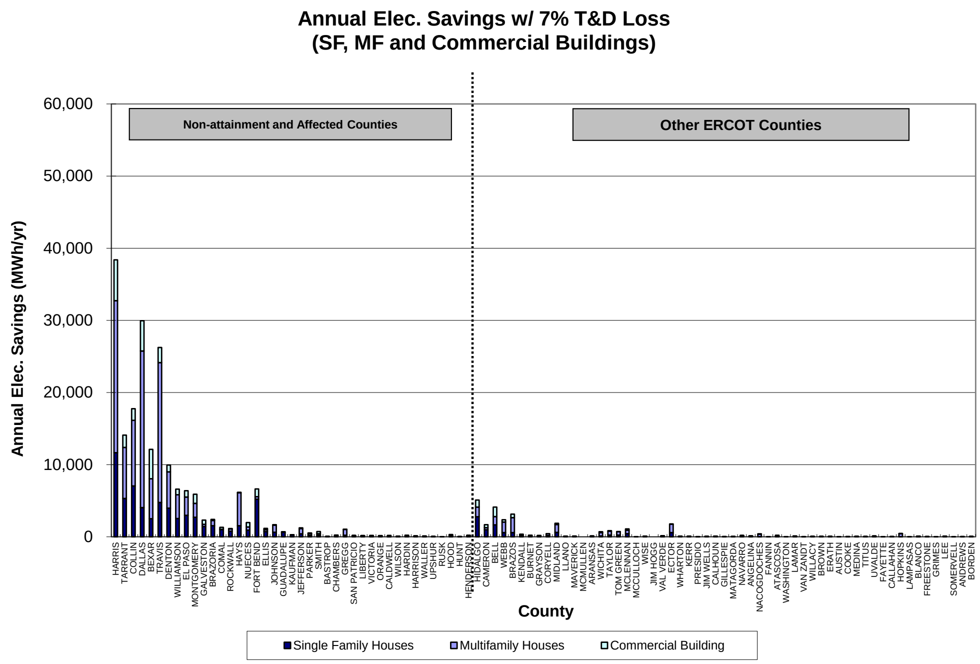
Using the 2010 eGRID, the total NOx reductions from electricity and natural gas savings from new residential (single-family and multi-family) and commercial construction in 2012 were calculated to be 85.43 tons NOx/year which represents 49.98 tons NOx/year from electricity savings and 35.45 tons NOx/year from natural gas savings.

Table 26: 2012 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the 2006 IECC for Single-family and Multi-family Residences and the ASHRAE Standard 90.1-2007 for Commercial Buildings by County (using 2010 eGRID)

	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Electricity Savings and Resultant NOx Reductions (Commercial Buildings)		Total Electricity Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Nox Reductions
County	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
HARRIS	11,645.82	1.85	21,070.45	2.41	5,675.06	0.73	38,391.33	4.99	163,936.53	0.75	1,526,201.95	7.02	12.01
TARRANT	5,316.17	0.03	7,061.75	0.06	1,715.96	0.01	14,093.88	0.11	136,799.72	0.63	348,215.90	1.60	1.71
COLLIN	7,047.38	0.09	9,085.60	0.18	1,616.19	0.04	17,749.17	0.31	177,194.80	0.82	534,850.89	2.46	2.77
DALLAS	4,045.56	0.18	21,697.04	0.34	4,198.98	0.08	29,941.58	0.59	238,007.86	1.09	750,307.48	3.45	4.04
BEXAR	2,498.22	0.95	5,535.85	1.91	4,072.72	0.52	12,106.79	3.38	64,160.47	0.30	536,843.44	2.47	5.85
TRAVIS	4,751.38	0.35	19,389.03	0.71	2,098.39	0.19	26,238.80	1.26	207,348.49	0.95	418,531.70	1.93	3.19
DENTON	3,971.33	0.01	5,030.27	0.02	951.80	0.00	9,953.40	0.03	99,126.88	0.46	188,312.87	0.87	0.90
WILLIAMSON	2,529.13		3,296.06		784.47	0.00	6,609.67	0.00	58,502.78	0.27	405,535.24	1.87	1.87
EL PASO	2,982.07		2,514.65		882.09	0.00	6,378.81	0.00	99,009.91	0.46	167,976.99	0.77	0.77
MONTGOMERY	2,692.55		1,942.55		1,265.11	0.00	5,900.21	0.00	37,284.56	0.17	216,116.94	0.99	0.99
GALVESTON	1,425.53	0.28	305.33	0.37	590.83	0.11	2,321.70	0.76	20,026.31	0.09	52,013.42	0.24	1.00
BRAZORIA	1,535.80	0.70	730.79	0.91	143.97	0.28	2,410.56	1.89	21,647.25	0.10	65,474.52	0.30	2.19
COMAL	982.59		51.00		282.44	0.00	1,316.03	0.00	12,559.22	0.06	78,700.58	0.36	0.36
ROCKWALL	774.75		305.96		48.77	0.00	1,129.49	0.00	13,871.06	0.06	15,069.23	0.07	0.07
HAYS	1,530.14	0.06	4,573.59	0.11	71.23	0.03	6,174.96	0.20	54,440.45	0.25	73,557.72	0.34	0.54
NUECES	924.27	0.88	429.62	1.77	619.25	0.48	1,973.14	3.13	9,377.26	0.04	127,448.87	0.59	3.71
FORT BEND	5,216.21	0.39	347.72	0.51	1,057.98	0.15	6,621.90	1.05	71,509.84	0.33	434,836.00	2.00	3.05
ELLIS	736.70	0.22	237.80	0.41	192.73	0.09	1,167.23	0.71	12,880.35	0.06	22,058.88	0.10	0.82
JOHNSON	639.32	0.05	971.90	0.10	76.22	0.02	1,687.43	0.17	17,457.56	0.08	21,968.52	0.10	0.27
GUADALUPE	634.77	0.22	0.00	0.44	64.44	0.12	699.21	0.78	7,917.05	0.04	26,907.20	0.12	0.90
KAUFMAN	251.36	0.43	0.00	0.81	33.28	0.18	284.64	1.43	3,696.79	0.02	23,263.41	0.11	1.53
JEFFERSON	411.81		733.15		85.54	0.00	1,230.50	0.00	5,980.73	0.03	17,107.92	0.08	0.08
PARKER	216.93	0.00	248.92	0.00	56.82	0.00	522.67	0.00	5,205.44	0.02	18,600.29	0.09	0.09
SMITH	205.78		231.16		285.07	0.00	722.01	0.00	3,460.87	0.02	37,014.09	0.17	0.17
BASTROP	40.65	0.23	0.00	0.46	20.10	0.13	60.75	0.82	1,319.89	0.01	3,212.17	0.01	0.84
CHAMBERS	223.01	0.25	0.00	0.33	18.20	0.10	241.21	0.69	3,093.48	0.01	8,162.78	0.04	0.72
GREGG	209.56		804.30		13.08	0.00	1,026.94	0.00	3,311.69	0.02	7,074.71	0.03	0.03
SAN PATRICIO	154.96	0.10	0.00	0.21	12.58	0.06	167.54	0.37	1,564.90	0.01	4,747.58	0.02	0.39
LIBERTY	132.43		6.72		5.04	0.00	144.19	0.00	1,848.02	0.01	1,959.24	0.01	0.01
VICTORIA	93.99	0.15	56.03	0.29	49.70	0.08	199.72	0.52	1,252.71	0.01	3,039.04	0.01	0.53
ORANGE	140.62		0.00		17.56	0.00	158.19	0.00	1,967.30	0.01	2,908.90	0.01	0.01
CALDWELL	6.44		9.62		183.26	0.00	199.32	0.00	87.68	0.00	4,967.12	0.02	0.02
WILSON	23.48		66.70		0.00	0.00	90.17	0.00	690.44	0.00	690.44	0.00	0.00
HARDIN	72.41		128.33		0.82	0.00	201.56	0.00	1,022.48	0.00	1,038.24	0.00	0.00
HARRISON	32.55		11.13		108.12	0.00	151.80	0.00	546.62	0.00	3,640.97	0.02	0.02
WALLER	6.40		105.32		0.00	0.00	111.72	0.00	109.91	0.00	109.91	0.00	0.00
UPSHUR	12.71		62.20		0.00	0.00	74.92	0.00	968.01	0.00	968.01	0.00	0.00
RUSK	3.21	0.00	0.00	0.00	0.00	0.00	3.21	0.00	58.10	0.00	58.10	0.00	0.00
HOOD	129.47	0.37	41.36	0.69	141.80	0.15	312.62	1.21	2,260.02	0.01	6,035.48	0.03	1.24
HUNT	29.80	0.61	0.00	1.22	5.56	0.32	35.36	2.15	439.32	0.00	1,121.62	0.01	2.15
HENDERSON	131.77	0.05	29.59	0.09	57.22	0.02	218.58	0.16	2,218.27	0.01	38,959.34	0.18	0.34
HIDALGO	2,770.53	0.37	1,340.59	0.74	980.61	0.20	5,091.74	1.31	22,377.07	0.10	399,734.68	1.84	3.15
CAMERON	978.29	0.44	287.13	0.87	400.28	0.24	1,665.70	1.55	7,846.20	0.04	125,873.91	0.58	2.12
BELL	1,644.32		1,166.35		1,304.64	0.00	4,115.31	0.00	43,891.24	0.20	118,241.55	0.54	0.54
WEBB	590.28	0.29	1,456.47	0.58	314.44	0.16	2,361.19	1.02	6,120.35	0.03	32,120.13	0.15	1.17
BRAZOS	581.89	0.17	2,066.26	0.33	494.59	0.08	3,142.74	0.58	8,405.03	0.04	61,809.85	0.28	0.86
KENDALL	216.51		0.00		153.14	0.00	369.65	0.00	2,918.14	0.01	7,263.87	0.03	0.03
BURNET	180.27		0.00		15.92	0.00	196.19	0.00	2,435.22	0.01	2,859.13	0.01	0.01
GRAYSON	81.36		15.53		87.53	0.00	184.42	0.00	1,326.97	0.01	38,242.78	0.18	0.18
CORYELL	183.49		250.62		0.00	0.00	434.11	0.00	6,061.51	0.03	6,061.51	0.03	0.03
MIDLAND	605.08		1,104.49		155.83	0.00	1,865.40	0.00	22,919.05	0.11	52,603.67	0.24	0.24
LLANO	39.70	0.28	24.06	0.55	7.20	0.15	70.96	0.98	713.97	0.00	872.87	0.00	0.98
MAVERICK	59.03		7.71		14.75	0.00	81.49	0.00	598.20	0.00	2,508.16	0.01	0.01
MCMULLEN	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ARANSAS	81.12		0.00		5.53	0.00	86.65	0.00	819.27	0.00	925.92	0.00	0.00
WICHITA	126.76	0.01	450.85	0.02	112.38	0.00	689.99	0.04	7,642.03	0.04	10,806.53	0.05	0.09
TAYLOR	232.65		552.90		72.96	0.00	858.50	0.00	10,019.44	0.05	47,755.55	0.22	0.22
TOM GREEN	233.44		459.81		31.50	0.00	724.74	0.00	8,150.57	0.04	9,752.73	0.04	0.04
MCLENNAN	435.58	0.41	455.45	0.77	195.14	0.17	1,086.18	1.35	13,041.64	0.06	118,411.54	0.54	1.90
MCCULLOCH	0.00		0.00		3.44	0.00	3.44	0.00	0.00	0.00	91.49	0.00	0.00
WISE	33.29	0.07	10.37	0.14	55.05	0.03	98.71	0.24	573.49	0.00	30,455.78	0.14	0.38
JIM HOGG	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
VAL VERDE	25.22		94.16		20.89	0.00	140.26	0.00	875.85	0.00	6,419.08	0.03	0.03
ECTOR	586.90	0.21	1,152.98	0.42	45.49	0.10	1,785.36	0.74	23,048.89	0.11	33,179.35	0.15	0.89
WHARTON	64.35	0.14	0.00	0.29	1.35	0.08	65.70	0.51	851.83	0.00	877.79	0.00	0.52
KERR	49.36		0.00		42.64	0.00	92.00	0.00	666.79	0.00	1,656.61	0.01	0.01
PRESIDIO	3.06		5.23		0.00	0.00	8.28	0.00	99.56	0.00	99.56	0.00	0.00
JIM WELLS	31.90		0.00		25.73	0.00	57.63	0.00	322.19	0.00	20,111.53	0.09	0.09
CALHOUN	54.19	0.06	14.01	0.13	1.80	0.04	70.00	0.23	719.48	0.00	754.25	0.00	0.23
GILLESPIE	36.48		0.00		0.00	0.00	36.48	0.00	492.84	0.00	492.84	0.00	0.00
MATAGORDA	60.12		0.00		0.00	0.00	60.12	0.00	795.79	0.00	795.79	0.00	0.00
NAVARRO	65.92		101.21		12.83	0.00	179.96	0.00	2,285.46	0.01	2,592.18	0.01	0.01
ANGELINA	44.15		3.28		85.18	0.00	132.61	0.00	799.79	0.00	3,989.68	0.02	0.02
NACOGDOCHES	30.51		337.46		48.58	0.00	416.55	0.00	653.13	0.00	5,226.54	0.02	0.02
FANNIN	20.63	0.00	0.00	0.00	0.00	0.00	20.63	0.00	304.14	0.00	304.14	0.00	0.00
ATASCOSA	45.94		15.62		157.89	0.00	219.44	0.00	725.00	0.00	22,867.79	0.11	0.11
WASHINGTON	28.01		0.00		0.00	0.00	28.01	0.00	383.65	0.00	383.65	0.00	0.00
LAMAR	9.38	0.29	62.23	0.54	40.52	0.12	112.12	0.95	670.93	0.00	13,540.25	0.06	1.02
VAN ZANDT	5.74		0.00		21.26	0.00	27.00	0.00	84.40	0.00	16,739.75	0.08	0.08
WILLACY	35.77		0.00		6.55	0.00	42.32	0.00	283.75	0.00	5,413.01	0.02	0.02
BROWN	50.77		0.00		13.36	0.00	64.13	0.00	1,007.39	0.00	11,472.26	0.05	0.05
ERATH	45.73		21.47		0.00	0.00	67.21	0.00	1,106.93	0.01	1,106.93	0.01	0.01
AUSTIN	16.81		0.00		0.00	0.00	16.81	0.00	230.19	0.00	230.19	0.00	0.00
COOKE	42.40		0.00		0.00	0.00	42.40	0.00	625.18	0.00	625.18	0.00	0.00
MEDINA	12.17		23.54		0.91	0.00	36.63	0.00	292.17	0.00	309.79	0.00	0.00
TITUS	11.08	0.00	5.19	0.00	7.15	0.00	23.42	0.00	239.54	0.00	5,840.46	0.03	0.03
UVALDE	18.26		62.77		16.04	0.00	97.07	0.00	601.98	0.00	1,028.93	0.00	0.00
FAYETTE	3.20	0.36	0.00	0.71	0.00	0.18	3.20	1.25	43.85	0.00	43.85	0.00	1.25
CALLAHAN	6.96		21.47		0.00	0.00	28.43	0.00	348.51	0.00	348.51	0.00	0.00
HOPKINS	10.33		414.87		26.83	0.00	452.03	0.00	3,510.35	0.02	7,728.04	0.04	0.04
LAMPASAS	6.24		0.00		0.00	0.00	6.24	0.00	0.00	0.00	123.71	0.00	0.00
BLANCO	2.15		62.55		5.15	0.00	69.85	0.00	490.86	0.00	628.10	0.00	0.00
FREESTONE	8.91	0.35	0.00	0.65	12.94	0.14	21.85	1.14	176.74	0.00	10,317.34	0.05	1.18
GRIMES	20.01	0.00	0.00	0.00	0.00	0.00	20.01	0.00	274.04	0.00	274.04	0.00	0.00
LEE	50.44		38.47		0.00	0.00	88.92	0.00	971.90	0.00	971.90	0.00	0.00
SOMERVELL	6.87		0.00		0.00	0.00	6.87	0.00	101.99	0.00	101.99	0.00	0.00
ANDREWS	54.55	0.00	0.00	0.01	0.00	0.00	54.55	0.01	1,068.31	0.00	1,068.31	0.00	0.02
BORDEN	15.71		0.00		44.40	0.00	60.12	0.00	1,130.12	0.01	35,914.75	0.17	0.17

Table 27: 2012 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the 2006 IECC for Single-family and Multi-family Residences and the ASHRAE Standard 90.1-2007 for Commercial Buildings by County (using 2010 eGRID) (Continued)

	Electricity Savings and Resultant NOx Reductions (Single Family Houses)		Electricity Savings and Resultant NOx Reductions (Multifamily Houses)		Electricity Savings and Resultant NOx Reductions (Commercial Buildings)		Total Electricity Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Natural Gas Savings and Resultant NOx Reductions (Single and Multi-Family Houses)		Total Natural Gas Savings and Resultant NOx Reductions (SF, MF and Commecial Buildings)		Total Nox Reductions
County	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual Electricity Savings per County w/ 7% T&D Loss (MWh/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Total Annual N.G. Savings (Therm/County)	Annual Nox Reductions (Tons)	Annual Nox Reductions (Tons)
CHEROKEE	14.45	0.20	3.28	0.37	79.65	0.08	97.38	0.65	262.41	0.00	52,323.16	0.24	0.89
DIMMIT	3.94		0.00		0.00	0.00	3.94	0.00	39.83	0.00	39.83	0.00	0.00
FALLS	5.34		0.00		0.00	0.00	5.34	0.00	106.04	0.00	106.04	0.00	0.00
COLORADO	12.01		0.00		30.03	0.00	42.04	0.00	164.42	0.00	926.99	0.00	0.00
FRIO	24.55	0.00	0.00	0.00	121.88	0.00	146.43	0.00	333.30	0.00	4,780.90	0.02	0.02
MILAM	2.23	0.09	0.00	0.17	0.00	0.05	2.23	0.31	31.24	0.00	31.24	0.00	0.31
JACKSON	8.47		0.00		33.33	0.00	41.80	0.00	112.08	0.00	25,597.27	0.12	0.12
ANDERSON	4.82		0.00		0.34	0.00	5.15	0.00	87.14	0.00	93.63	0.00	0.00
HILL	1.78		0.00		26.30	0.00	28.09	0.00	35.35	0.00	20,640.82	0.09	0.09
CULBERSON	0.74		0.00		0.00	0.00	0.74	0.00	21.17	0.00	21.17	0.00	0.00
MASON	3.22		0.00		0.00	0.00	3.22	0.00	43.49	0.00	43.49	0.00	0.00
PECOS	6.12	0.00	0.00	0.00	3.01	0.00	9.13	0.01	104.77	0.00	2,463.05	0.01	0.02
RAINS	2.30		0.00		0.00	0.00	2.30	0.00	33.76	0.00	33.76	0.00	0.00
LAVACA	14.04		0.00		25.96	0.00	40.00	0.00	190.71	0.00	20,530.87	0.09	0.09
PALO PINTO	8.95	0.26	0.00	0.49	6.53	0.11	15.48	0.86	175.02	0.00	348.85	0.00	0.86
KIMBLE	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MADISON	27.21		0.00		0.00	0.00	27.21	0.00	372.69	0.00	372.69	0.00	0.00
ARCHER	4.30		0.00		0.00	0.00	4.30	0.00	96.25	0.00	96.25	0.00	0.00
REFUGIO	8.47		0.00		0.00	0.00	8.47	0.00	112.08	0.00	112.08	0.00	0.00
LIMESTONE	0.89	0.00	0.00	0.00	0.00	0.00	0.89	0.00	17.67	0.00	17.67	0.00	0.00
CLAY	1.07		0.00		0.00	0.00	1.07	0.00	24.06	0.00	24.06	0.00	0.00
BEE	7.62		0.00		15.05	0.00	22.67	0.00	100.87	0.00	11,892.27	0.05	0.05
MARTIN	4.04		0.00		48.94	0.00	52.98	0.00	79.13	0.00	1,159.62	0.01	0.01
GONZALES	0.87		0.00		3.76	0.00	4.63	0.00	10.85	0.00	2,958.70	0.01	0.01
BURLESON	28.01		0.00		0.00	0.00	28.01	0.00	383.65	0.00	383.65	0.00	0.00
KARNES	47.87		0.00		0.00	0.00	47.87	0.00	649.69	0.00	649.69	0.00	0.00
KLEBERG	16.98		61.64		0.00	0.00	78.62	0.00	184.42	0.00	184.42	0.00	0.00
BREWSTER	7.14		15.68		8.28	0.00	31.09	0.00	263.77	0.00	1,840.95	0.01	0.01
WINKLER	2.02		0.00		9.39	0.00	11.41	0.00	39.57	0.00	289.64	0.00	0.00
FRANKLIN	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
YOUNG	28.83	0.52	0.00	0.96	1.43	0.22	30.26	1.70	563.95	0.00	1,684.14	0.01	1.70
HOUSTON	4.01		0.00		0.00	0.00	4.01	0.00	72.62	0.00	72.62	0.00	0.00
SCURRY	42.18		118.26		0.00	0.00	160.44	0.00	4,620.29	0.02	4,620.29	0.02	0.02
BOSQUE	1.78	0.16	0.00	0.30	0.00	0.07	1.78	0.53	35.35	0.00	35.35	0.00	0.53
COMANCHE	0.89		0.00		0.00	0.00	0.89	0.00	17.67	0.00	17.67	0.00	0.00
BRISCOE	8.83		0.00		0.00	0.00	8.83	0.00	270.66	0.00	270.66	0.00	0.00
CONCHO	1.02		0.00		0.00	0.00	1.02	0.00	17.46	0.00	17.46	0.00	0.00
ZAVALA	5.51		0.00		0.00	0.00	5.51	0.00	55.76	0.00	55.76	0.00	0.00
NOLAN	0.99	0.03	0.00	0.06	10.16	0.01	11.15	0.10	19.45	0.00	7,978.64	0.04	0.13
BROOKS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROBERTSON	17.61	0.27	0.00	0.54	0.00	0.14	17.61	0.96	241.15	0.00	241.15	0.00	0.96
LIVE OAK	11.85		0.00		22.47	0.00	34.32	0.00	119.67	0.00	17,229.72	0.08	0.08
HAMILTON	1.78		0.00		0.00	0.00	1.78	0.00	35.35	0.00	35.35	0.00	0.00
JONES	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REAGAN	2.01		0.00		0.00	0.00	2.01	0.00	40.21	0.00	40.21	0.00	0.00
WARD	10.10	0.20	0.00	0.39	0.00	0.08	10.10	0.67	197.84	0.00	197.84	0.00	0.67
RED RIVER	5.97		0.00		0.00	0.00	5.97	0.00	106.38	0.00	106.38	0.00	0.00
HASKELL	1.99		0.00		0.00	0.00	1.99	0.00	38.89	0.00	38.89	0.00	0.00
HOWARD	15.15	0.13	0.00	0.26	23.46	0.05	38.61	0.44	296.75	0.00	18,003.27	0.08	0.52
SAN SABA	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JACK	9.94	0.22	0.00	0.42	15.65	0.09	25.60	0.73	194.47	0.00	12,457.52	0.06	0.79
STEPHENS	2.98		0.00		0.00	0.00	2.98	0.00	58.34	0.00	58.34	0.00	0.00
RUNNELS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REEVES	2.02		0.00		3.76	0.00	5.78	0.00	39.57	0.00	2,987.42	0.01	0.01
DE WITT	3.39		0.00		0.00	0.00	3.39	0.00	44.83	0.00	44.83	0.00	0.00
CHILDRESS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CROSBY	6.62		0.00		0.00	0.00	6.62	0.00	475.84	0.00	475.84	0.00	0.00
DAWSON	9.98		0.00		12.47	0.00	22.45	0.00	700.90	0.00	2,448.06	0.01	0.01
MITCHELL	3.98	0.03	0.00	0.06	0.00	0.01	3.98	0.10	77.79	0.00	77.79	0.00	0.10
WILBARGER	0.00	1.31	0.00	2.44	0.26	0.54	0.26	4.29	0.00	0.00	206.35	0.00	4.29
COLEMAN	0.99		0.00		0.00	0.00	0.99	0.00	19.45	0.00	19.45	0.00	0.00
UPTON	7.02	0.00	0.00	0.00	15.80	0.00	22.83	0.01	140.74	0.00	12,521.71	0.06	0.07
COKE	1.02	0.00	0.00	0.00	0.00	0.00	1.02	0.00	17.70	0.00	17.70	0.00	0.00
CROCKETT	19.37		0.00		0.00	0.00	19.37	0.00	331.77	0.00	331.77	0.00	0.00
HARDEMAN	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BANDERA	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAYLOR	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COTTLE	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRANE	4.01		0.00		0.00	0.00	4.01	0.00	80.42	0.00	80.42	0.00	0.00
DELTA	4.59		0.00		0.00	0.00	4.59	0.00	67.52	0.00	67.52	0.00	0.00
DICKENS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DUVAL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EASTLAND	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EDWARDS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FISHER	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FOARD	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GLASSCOCK	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GOLIAD	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HALL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HUDSPETH	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRION	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JEFF DAVIS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KENEDY	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KENT	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KING	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KINNEY	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KNOX	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LA SALLE	3.94		196.51		0.00	0.00	200.44	0.00	59.53	0.00	59.53	0.00	0.00
LEON	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LOVING	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MENARD	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MILLS	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MONTAGUE	11.46		0.00		0.00	0.00	11.46	0.00	168.97	0.00	168.97	0.00	0.00
MOTLEY	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REAL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SCHLEICHER	5.10		0.00		47.02	0.00	52.12	0.00	87.31	0.00	1,125.42	0.01	0.01
SHACKELFORD	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STARR	1.93		0.00		5.50	0.00	7.43	0.00	15.34	0.00	161.72	0.00	0.00
STERLING	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STONEWALL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUTTON	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TERRELL	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
THROCKMORTON	0.00		0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZAPATA	0.00		0.00		2.38	0.00	2.38	0.00	0.00	0.00	45.90	0.00	0.00
TOTAL	**75,591.15**	**15.35**	**119,591.95**	**27.58**	**33,117.61**	**7.05**	**228,300.71**	**49.98**	**1,789,709.33**	**8.23**	**7,707,541.87**	**35.45**	**85.43**



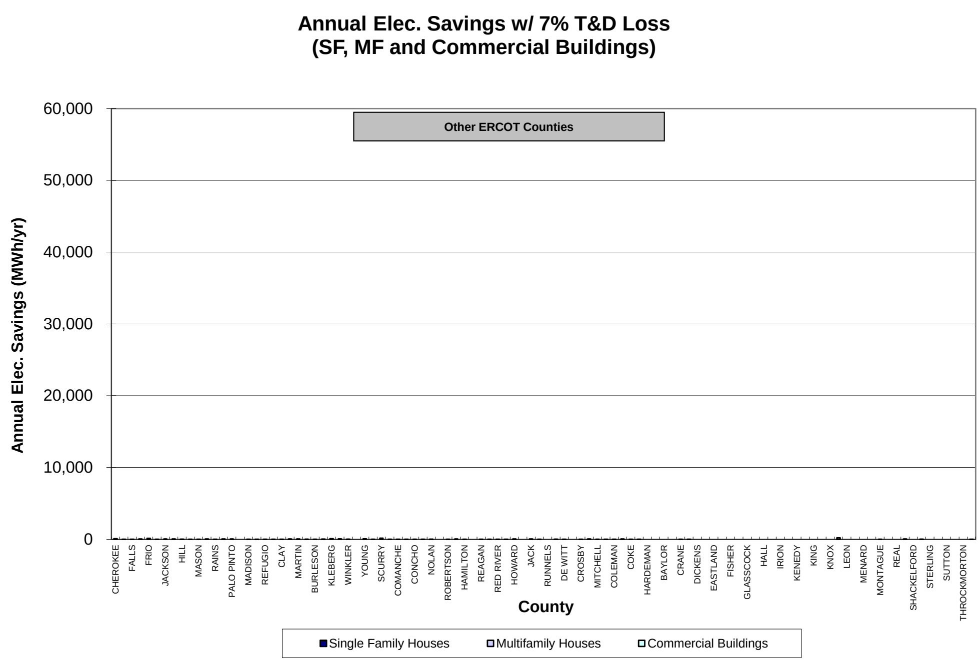


Figure 57: 2012 Annual Electricity Reductions from the 2006 IECC for Single-family and Multi-family Residences and the ASHRAE Standard 90.1-2007 for Commercial Buildings by County

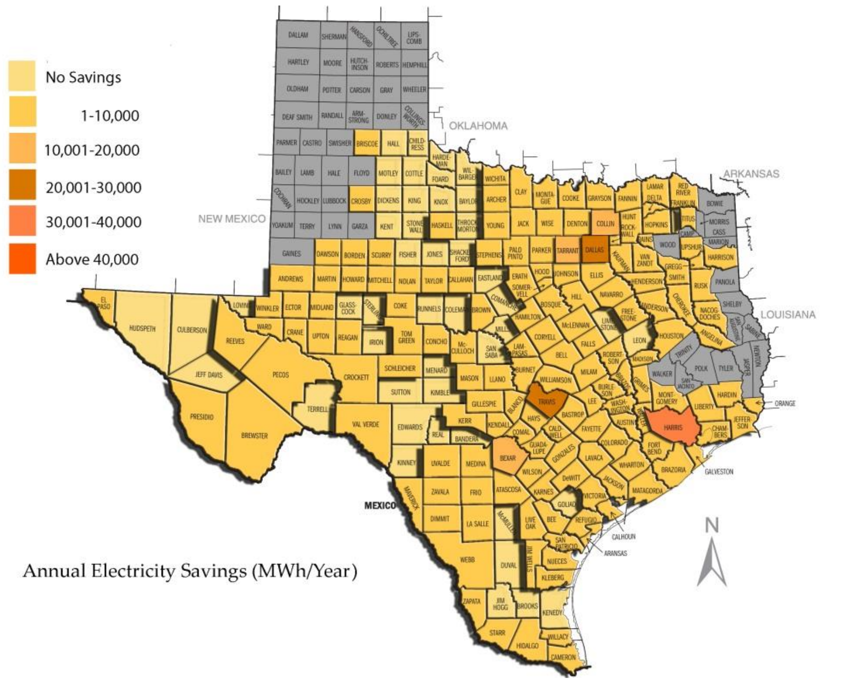
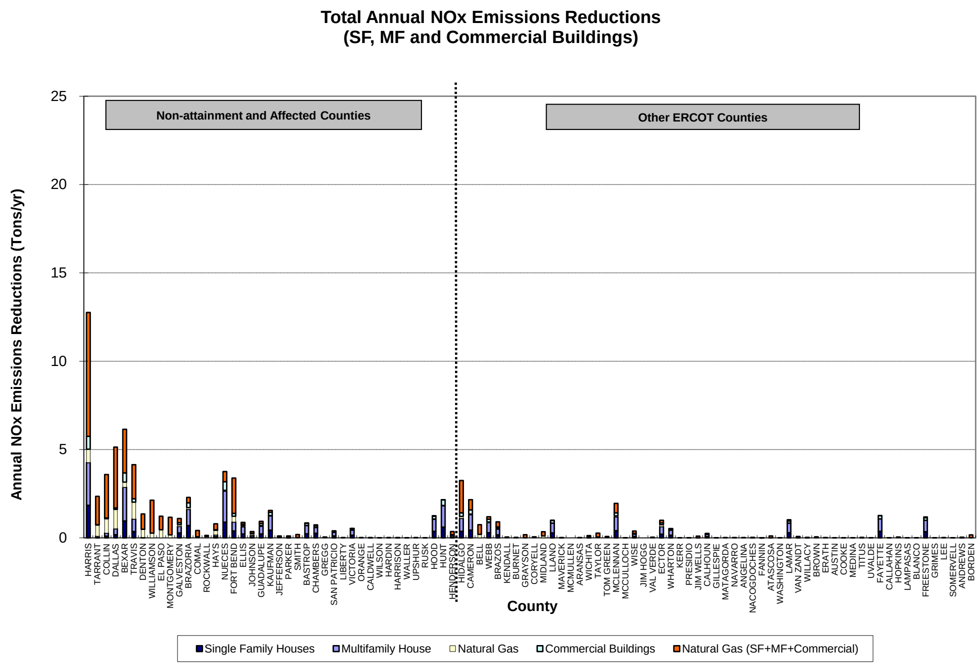


Figure 58: 2012 Annual Electricity Reductions from the 2006 IECC for Single-family and Multi-family Residences and the ASHRAE Standard 90.1-2007 for Commercial Buildings by County



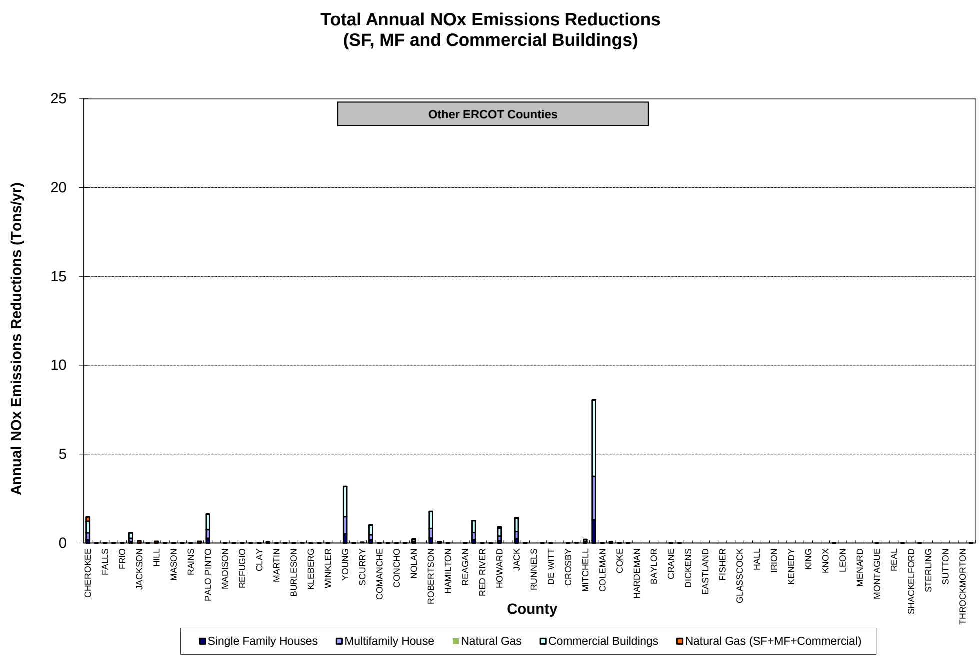


Figure 59: 2012 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the 2006 IECC for Single-family and Multi-family Residences and the ASHRAE Standard 90.1-2007 for Commercial Buildings by County (using 2010 eGRID)

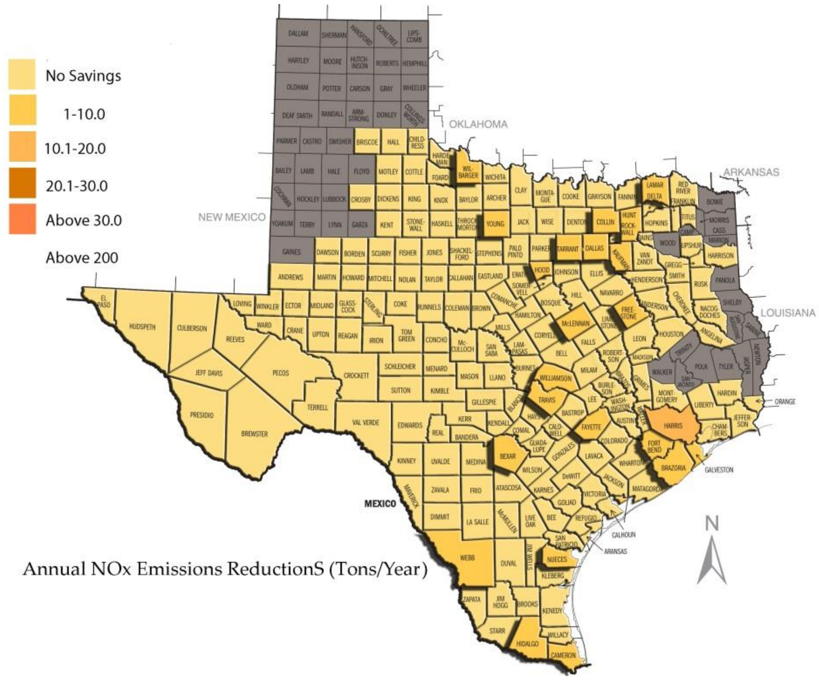


Figure 60: 2012 Annual NOx Reductions from Electricity and Natural Gas Savings Due to the 2006 IECC for Single-family and Multi-family Residences and the ASHRAE Standard 90.1-2007 for Commercial Buildings by County (using 2010 eGRID)

5. Calculation of Integrated NOx Emissions Reductions from Multiple State Agencies Participating in the Texas Emissions Reduction Plan (TERP)

5.1 Background

In January 2005, the Laboratory was asked by the Texas Commission on Environmental Quality (TCEQ) to develop a method by which the NOx emissions savings from the energy-efficiency programs from multiple Texas State Agencies working under Senate Bill 5 and Senate Bill 7 could be reported in a uniform format to allow the TCEQ to consider the combined savings for Texas' State Implementation Plan (SIP) planning purposes. This required that the analysis should include the integrated savings estimates from all projects projected through 2020 for both the annual and Ozone Season Day (OSD) NOx reductions. The NOx emissions reduction from all these programs were calculated using estimated emissions factors for 2010 from the US Environmental Protection Agency (US EPA) eGRID database, which had been specially prepared for this purpose. The different programs included in this 2012 integrated analysis are:

- ESL Single-family new construction
- ESL Multi-family new construction
- ESL Commercial new construction
- PUC Senate Bill 7 Program
- SECO Senate Bill 5 Program
- Electricity generated by wind farms in Texas (ERCOT)[29]
- SEER 13 upgrades to Single-family and Multi-family residences

The Laboratory's single-family and multi-family programs include the energy savings obtained by new built residences in Texas. The baseline to estimate energy savings uses the published data on residential construction characteristics by the 2008 National Association of Home Builders (NAHB 2008) based on the IECC 2006 building code (ICC 2006). Annual electricity savings (MWh) are obtained from the Laboratory's Annual Reports to the TCEQ (Haberl et al., 2002 - 2012).

The Laboratory's commercial program includes the energy savings attained by new commercial buildings in Texas, including office, apartment, healthcare, education, retail, food and lodging buildings as defined by Dodge types (Dodge 2011). Energy savings were estimated from code compliant buildings (ASHRAE standard 90.1-2007) against pre-code buildings (ASHRAE standard 90.1-2004) using EUI's from the USDOE report and building square footage provided in the Dodge data (Dodge 2011).

The Texas Public Utility Commission's (PUC) Senate Bill 7 program include the energy efficiency programs implemented by electric utilities under the Public Utility Regulatory Act §39.905 (PUC 2013). The PUC regulated energy efficiency program was adopted pursuant to 1999 legislation (SB 7) and subsequent legislation in 2001 (SB 5), 2007 (HB 3693), and 2011 (SB 1125). The energy efficiency measures include high efficiency HVAC equipment, variable speed drives, increased insulation levels, infiltration reduction, duct sealing, Energy Star Homes, etc. Annual electricity savings according to the utilities were reported for the different programs completed in the years 2001 through 2012.

The Texas State Energy Conservation Office (SECO) funds energy-efficiency programs that are directed towards school districts, government agencies, city and county governments, private industries and residential energy consumers. For the 2012 reporting year SECO submitted annual energy savings values for projects funded by SECO and by Energy Service projects.

The *Electric Reliability Council of Texas (ERCOT) electricity production from currently installed green power generation (wind)* in Texas is reported. Projections through 2013 include planned projects by ERCOT, annual growth factors beyond 2013 comply with the Legislative requirements. Actual measured electricity production for 2001 through 2012, were included.

[29] ERCOT is the Electric Reliability Council of Texas.

Finally, NOx emissions reductions from *the installation of SEER 13 air conditioners in existing residences* are also reported.

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5.2 Description of the Analysis Method

Annual and Ozone Season Day (OSD) NOx emissions reduction were calculated for 2012 and integrated from 2009 to 2020 using several factors to discount the potential savings. These factors include an annual degradation factor, a transmission and distribution factor, a discount factor, and growth factors as shown in Table 27 and are described as follows:

Annual degradation factor: This factor was used to account for an assumed decrease in the performance of the measures installed as the equipment wears down and degrades. With the exception of electricity generated from wind, an annual degradation factor of 2% was used for ESL Single-family, Multi-family, and commercial programs and an annual degradation factor of 5% was used for all other programs[30]. The value of the 5% degradation factor was taken from a study by Kats et al. (1996).

Transmission and distribution loss: This factor adjusts the reported savings to account for the loss in energy resulting from the transmission and distribution of the power from the electricity producers to the electricity consumers. For this calculation, the energy savings reported at the consumer level are increased by 7% to give credit for the actual power produced that is lost in the transmission and distribution system on its way to the customer. In the case of electricity generated by wind, the T&D losses were assumed to cancel out since wind energy is displacing power produced by conventional power plants; therefore, there is no net increase or decrease in T&D losses.

Initial discount factor: This factor was used to discount the reported savings for any inaccuracies in the assumptions and methods employed in the calculation procedures. For the Laboratory's single, multi-family and commercial program, the discount factor was assumed to be 20%. For PUC's Senate Bill 7 program and electricity from wind, the discount factor was taken as 10%. For the savings in the SECO program, the discount factor was 60%. In addition, the discount factor for SEER 13 single-family and SEER 13 multi-family program was 20%.

Growth factor: The growth factors shown in Table 26 were used to account for several different factors. Growth factors for single-family (3.3%), multi-family residential (1.5%), and commercial (3.3%) construction are projections based on the average growth rate for these housing types from recent U.S. Census data for Texas. Growth factor for wind energy (3.9%) is a linear projection based on the installed wind power capacity for 2009 through 2012 from the Texas Public Utilities Commission. No growth was assumed for PUC programs, SECO, and SEER 13 entries.

Figure 61 shows the overall information flow that was used to calculate the NOx emissions savings from the annual and Ozone Season Day (OSD) electricity savings (MWh) from all programs. For the Laboratory's single-family and multi-family code-implementation programs, the annual and OSD were calculated from DOE-2 hourly simulation models[31]. The base case is taken as the average characteristics of single- and multi-family residences for Texas published by the National Association of Home Builders for 2008 (NAHB 2008). The annual electricity savings from PUC programs were calculated using demand savings tables created for the utilities incentive programs by Frontier Associates in Austin, Texas (PUC 2013). The OSD consumption is the average daily consumption for the period between July 15 and September 15.

[30] A degradation of 5% per year would accumulate as a 5%, 10%, 15%...etc, degradation in performance. Although the assumption of this high level of degradation may not actually occur, it was chosen as a conservative estimate. For wind energy, a degradation factor of 0% was used. The choice of a 0% degradation factor for wind is based on two year's of analysis of measured wind data from all Texas wind farms that shows no degradation, on average, for a two year period after the wind farms became operational.

[31] These values are based on a performance analysis as defined by Chapter 4 of IECC 2006. This analysis is discussed in the Laboratory's annual reports to the TCEQ.

The SECO electricity savings were submitted as annual savings by project[32]. A description of the measures completed for the project was also submitted for information purposes. The electricity production from wind farms in Texas was from the actual on-site metered data measured at 15-minute intervals.

Integration of the savings from the different programs into a uniform format allowed for creditable NOx emissions to be evaluated using different criteria as shown in Table 26. These include evaluation across programs, evaluation across individual counties by program, evaluation by SIP area, evaluation for all ERCOT counties except Houston/Galveston, and evaluation within a 200 km radius of Dallas/Ft.Worth.

5.3 Calculation Procedure

The electricity savings in this report was estimated based on the baseline year of 2008. In addition, the emissions estimation throughout this report was based on the 2010 eGrid database which is using the four different Congestion Management (CM) zones: Houston, North, West, and South. This report calculates the OSD emissions reductions by dividing the annual emissions reductions with 365 since the 2010 eGrid estimates the annual emissions only. However, the OSD emissions reduction from the Electricity Generated by Wind Farms was estimated by actual measured data.

ESL Single-family and Multi-family. The calculation of the annual electricity savings reported for the years 2002 through 2012 included the savings from code-compliant new housing in all 41 non-attainment and affected counties as reported in the Laboratory's annual report submitted by the Laboratory to the Texas Commission of Environmental Quality (TCEQ). From 2009 to 2012, based on year 2008, the annual electricity savings were calculated for new residential construction in all the counties in ERCOT region, which includes the 41 non-attainment and affected counties. These savings were then tabulated by county and program. Using the calculated values through 2012, savings were then projected to 2020 by incorporating the different adjustment factors mentioned above.

In these calculations, it was assumed that the same amount of electricity savings from the code-complaint construction would be achieved for each year after 2012 through 2020[33]. The projected energy savings through 2020, according to county, were then divided into the CM zones in the 2010 eGRID. To determine which CM zone was to be used, or in counties with multiple CM zone, the allocation to each CM zone by county was obtained from CM zone's listing published in the Laboratory's 2010 annual report[34].

For the 2012 annual NOx emissions calculations, the US EPA's 2010 eGRID were used. An example of the eGRID spreadsheet[35] is given in the Table 28 The total electricity savings for each CM zone were used to calculate the NOx emissions reduction for each of the different counties using the emissions factors contained in eGRID. Similar calculations were performed for each year for which the analysis was required.

ESL-Commercial Buildings. The annual electricity savings for 2004 through 2012 for commercial buildings were obtained from the annual reports for 2004 through 2012 submitted by the Laboratory to TCEQ[36]. From 2009 to 2012, based on year 2008, the annual electricity savings were also calculated for new commercial construction by county. Using the calculated values through 2012, savings were then projected to 2020 by incorporating the different adjustment factors mentioned above[37]. In the projected annual electricity savings, it was assumed that the same 2012 amount of electricity savings would be achieved for each year through 2020. Similarly to the single family

[32] The reporting requirements to the SECO did not require energy savings by project type, although for selected sites, energy savings by project type was available.
[33] This would include the appropriate discount and degradation factors for each year.
[34] Haberl et al., 2010, pp. 265.
[35] To use this spreadsheet electricity savings for each eGrid zone is entered in the bottom row of the spreadsheet (MWh). The spreadsheet then allocates the MWh of electricity savings according to the counties (blue columns) where the CM zone owned and operated a power plant. Totals for all CM zones are then listed on the far right columns (white columns). Similar spreadsheets for the 2010 eGRID exist for SOx and CO2.
[36] These savings include new construction in office, education, retail, food, lodging and warehouse construction as defined by Dodge building type (Dodge 2011), using energy savings from the US DOE's report (USDOE 2011), and data from CBECS (1995 - 2003).
[37] This also includes the appropriate discount and degradation factors for each year.

calculations, the projected energy saving numbers through 2020, by county, were allocated into the appropriate CM zones

PUC-Senate Bill 7. For the PUC Senate Bill 7 program savings, the annual electricity savings for 2001 through 2012 were obtained from the Public Utilities Commission. Using these values savings were projected through 2020 by incorporating the different adjustment factors mentioned above. Similar savings were assumed for each year after 2012 until 2020. The 2010 annual eGRID was also used to calculate the NOx emissions savings for the PUC-Senate Bill 7 program. The total electricity savings for each CM zone was used to calculate the NOx emissions reduction for each county using the emissions factors contained in the US EPA's eGRID spreadsheet. The integrated NOx emissions reduction for each county was then calculated.

SECO Savings. The annual electricity savings from energy conservation projects reported by political subdivisions for 39 counties through 2012 were obtained from the State Energy Conservation Office. These submittals included information gathered from SECO's website[38] and paper submittals[39]. The annual and average day electricity values were then summarized according to county and program. Using the actual reported numbers for 2007 through 2012, savings through 2020 were projected using the different adjustment factors mentioned above. In a similar fashion to the previous programs, it was assumed that the same amount of electricity savings will be achieved for each year through 2020. The 2010 annual eGRID were then used to calculate the NOx emissions savings for the SECO program.

Electricity Generated by Wind Farms. The measured electricity production from all the wind farms in Texas for 2001 through 2012 was obtained from the Energy Reliability Council of Texas (ERCOT). To obtain the annual production, the 15-minute data were summed for the 12 months. Using the reported numbers for 2012, savings through 2020 were projected incorporating the different adjustment factors mentioned above. The 2007 annual eGRID were then used to calculate the NOx emissions reduction for the electricity generated by Texas' wind farms[40]. The total electricity savings for each CM zone was used to calculate the NOx emissions reduction for each of the different counties.

SEER 13 Single-Family and Multi-Family. In January of 2006, Federal regulations mandated that the minimum efficiency for residential air conditioners be increased to SEER 13 from the previous SEER 10. Although the electricity savings from new construction reflected this change in values, the annual and OSD electricity savings from the replacement of the air conditioning units by air conditioners with an efficiency of SEER 13 in existing residences needed to be calculated.

In the 2012 report to the TCEQ, the annual and OSD electricity savings for all the counties in ERCOT region as well as the 41 non-attainment and affected counties were calculated. Using the numbers for 2006, the savings after 2006 until 2020 were projected by incorporating the appropriate adjustment factors[41]. In this analysis, it was assumed that an equal number of existing houses had their air conditioners replaced, as reported for 2006, by the air conditioner manufacturers. This replacement rate continued until all the existing air conditioner stock was replaced with SEER 13 air conditioners. The total electricity savings for each PCA were used to calculate the NOx emissions reduction for each of the different county using the emissions factors contained in the 2010 eGRID. Integrated NOx emissions reduction for each county by SIP area was also calculated.

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[38] This web site was developed for SECO by the Laboratory, at the request of the TCEQ.

[39] In these submittals, there were several municipalities whose electricity or natural consumption increased in 2004 as compared to 2001, which caused the reported savings from these municipalities to be negative. Since no additional information was reported from these projects that might have indicated what the cause of this was, it was assumed that the energy conservation projects were working as designed, but that other factors had changed the energy consumption. Therefore, in the final values of electricity savings from the political subdivisions that reported to SECO for the calculation of annual NOx reductions, the negative savings were omitted.

[40] This credited the electricity generated by the wind farm to the utility that either owned the wind farm or was associated with the wind farm owner.

[41] Additional details about this calculation are contained in the Laboratory's 2006 Annual Report to the TCEQ, available at the Senate Bill 5 web site "eslsb5.tamu.edu".

5.4 Results

The total integrated annual and OSD electricity savings for all the different programs in the integrated format was calculated using the adjustment factors shown in Table 27 for 2009 through 2020 as shown in Table 29. Annual and OSD NOx emissions reduction from the electricity savings (presented in Table 1) for all the programs in the integrated format is shown in Table 30.

In 2012, the total integrated annual savings from all programs is 16,413,917 MWh/year. The integrated annual electricity savings from all the different programs is:

- Savings from code-compliant residential and commercial construction is 498,883 MWh/year (3.0% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program is 1,831,318 MWh/year (11.2%),
- Savings from SECO's Senate Bill 5 program is 714,891 MWh/year (4.4%),
- Electricity savings from green power purchases (wind) is 13,049,580 MWh/year (79.5%), and
- Savings from residential air conditioner retrofits[42] is 319,244 MWh/year (1.9%).

In 2012, the total integrated OSD savings from all programs is 44,366 MWh/day, which would be a 1,849 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs is:

- Savings from code-compliant residential and commercial construction is 1,852 MWh/day (4.2%),
- Savings from the PUC's Senate Bill 7 programs is 5,017 MWh/day (11.3%),
- Savings from SECO's Senate Bill 5 program is 1,959 MWh/day (4.4%),
- Electricity savings from green power purchases (wind) are 33,273 MWh/day (75.0%), and
- Savings from residential air conditioner retrofits are 2,264 MWh/day (5.1%).

By 2013, the total integrated annual savings from all programs is 17,661,268 MWh/year. The integrated annual electricity savings from all the different programs is:

- Savings from code-compliant residential and commercial construction is 682,701 MWh/year (3.9% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program is 2,205,082 MWh/year (12.5%),
- Savings from SECO's Senate Bill 5 program is 909,903 MWh/year (5.2%),
- Electricity savings from green power purchases (wind) is 13,560,301 MWh/year (76.8%), and
- Savings from residential air conditioner retrofits is 303,282 MWh/year (1.7%).

By 2013, the total integrated OSD savings from all programs is 47,607 MWh/day, which would be a 1,984 MW average hourly load reduction during the OSD period. The integrated OSD electricity savings from all the different programs is:

- Savings from code-compliant residential and commercial construction is 2,346 MWh/day (4.9%),
- Savings from the PUC's Senate Bill 7 programs is 6,041 MWh/day (12.7%),
- Savings from SECO's Senate Bill 5 program is 2,493 MWh/day (5.2%),
- Electricity savings from green power purchases (wind) are 34,575 MWh/day (72.6%), and
- Savings from residential air conditioner retrofits are 2,151 MWh/day (4.5%).

In 2012, the total integrated annual NOx emissions reduction from all programs is 4,609 tons-NOx/year. The integrated annual NOx emissions reduction from all the different programs is:

[42] This assumes air conditioners in existing homes are replaced with the more efficient SEER 13 units, versus an average of SEER 11, which is slightly more efficient than the previous minimum standard of SEER 10.

- NOx emissions reduction from code-compliant residential and commercial construction is 126 tons-NOx/year (2.7% of the total NOx savings),
- NOx emissions reduction from the PUC's Senate Bill 7 programs is 522 tons-NOx/year (11.3%),
- NOx emissions reduction from SECO's Senate Bill 5 program is 221 tons-NOx/year (4.8%),
- NOx emissions reduction from green power purchases (wind) is 3,665 tons-NOx/year (79.5%), and
- NOx emissions reduction from residential air conditioner retrofits is 75 tons-NOx/year (1.6%).

In 2012, the total integrated OSD NOx emissions reduction from all programs is 12.35 tons-NOx/day. The integrated OSD NOx emissions reduction from all the different programs is:

- NOx emissions reduction from code-compliant residential and commercial construction is 0.47 tons-NOx/day (3.8%),
- NOx emissions reduction from the PUC's Senate Bill 7 programs is 1.43 tons-NOx/day (11.6%),
- NOx emissions reduction from SECO's Senate Bill 5 program is 0.60 tons-NOx/day (4.9%),
- NOx emissions reduction from green power purchases (wind) are 9.32 tons-NOx/day (75.5%), and
- NOx emissions reduction from residential air conditioner retrofits are 0.53 tons-NOx/day (4.3%).

By 2013, the total integrated annual NOx emissions reduction from all programs will be 4,959 tons-NOx/year. The integrated annual NOx emissions reduction from all the different programs is:

- NOx emissions reduction from code-compliant residential and commercial construction will be 172 tons-NOx/year (3.5% of the total NOx savings),
- NOx emissions reduction from the PUC's Senate Bill 7 programs will be 629 tons-NOx/year (12.7%),
- NOx emissions reduction from SECO's Senate Bill 5 program will be 277 tons-NOx/year (5.6%),
- NOx emissions reduction from green power purchases (wind) will be 3,809 tons-NOx/year (76.8%), and
- NOx emissions reduction from residential air conditioner retrofits will be 71 tons-NOx/year (1.4%).

By 2013, the total integrated OSD NOx emissions reduction from all programs is 13.26 tons-NOx/day. The integrated OSD NOx emissions reduction from all the different programs is:

- NOx emissions reduction from code-compliant residential and commercial construction will be 0.59 tons-NOx/day (4.5%),
- NOx emissions reduction from the PUC's Senate Bill 7 programs will be 1.72 tons-NOx/day (13.0%),
- NOx emissions reduction from SECO's Senate Bill 5 program will be 0.76 tons-NOx/day (5.7%),
- NOx emissions reduction from green power purchases (wind) will be 9.69 tons-NOx/day (73.1%), and
- NOx emissions reduction from residential air conditioner retrofits will be 0.50 tons-NOx/day (3.8%).

Table 27: Final Adjustment Factors used for the Calculation of the Annual and OSD NOx Savings for the Different Programs

	ESL- Single Family	ESL- Multi Family	ESL- Commercial	PUC (SB7)	SECO	Wind-ERCOT	SEER13 Single Family	SEER13 Multi Family
Annual Degradation Factor	2.0%	2.0%	2.0%	5.0%	5.0%	0.0%	5.0%	5.0%
T&D Loss	7.0%	7.0%	7.0%	7.0%	7.0%	0.0%	7.0%	7.0%
Initial Discount Factor	20.0%	20.0%	20.0%	10.0%	60.0%	10.0%	20.0%	20.0%
Growth Factor	3.3%	1.5%	3.3%	0.0%	0.0%	3.9%	N.A.	N.A.
Weather Normalized	Yes	Yes	Yes	No	No	No[1]	Yes	Yes

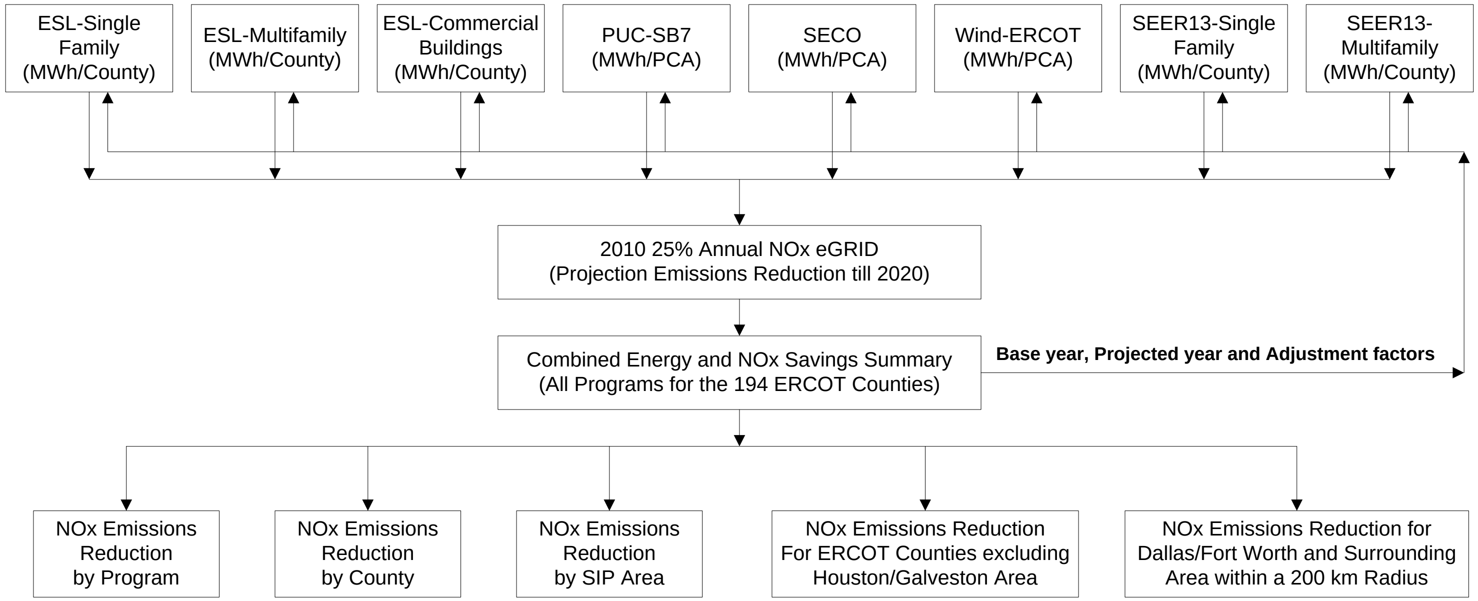

Figure 61: Process Flow Diagram of the NOx Emissions Reduction Calculations

Table 28: Example of NOx Emissions Reduction Calculations using 2010 eGRID

Area	County	CM Zones								Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
		H		N		W		S			
Houston-Galveston Area	Brazoria	0.0562032	347.6943	0.0000071	0.0710	0.0000003	0.0002	0.0005265	3.8055	351.57	0.18
	Chambers	0.0204500	126.5115	0.0000026	0.0258	0.0000001	0.0001	0.0001916	1.3847	127.92	0.06
	Fort Bend	0.0313463	193.9202	0.0000040	0.0396	0.0000002	0.0001	0.0002937	2.1224	196.08	0.10
	Galveston	0.0226620	140.1955	0.0000029	0.0286	0.0000001	0.0001	0.0002123	1.5344	141.76	0.07
	Harris	0.1486911	919.8596	0.0000189	0.1877	0.0000009	0.0006	0.0013930	10.0678	930.12	0.47
	Liberty	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Montgomery	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Waller	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Beaumont/ Port Arthur Area	Hardin	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Jefferson	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Orange	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Dallas/ Fort Worth Area	Collin	0.0012932	8.0000	0.0079329	78.9444	0.0003832	0.2345	0.0000809	0.5849	87.76	0.04
	Dallas	0.0024826	15.3584	0.0152295	151.5565	0.0007356	0.4503	0.0001554	1.1230	168.49	0.08
	Denton	0.0001267	0.7836	0.0007770	7.7325	0.0000375	0.0230	0.0000079	0.0573	8.60	0.00
	Tarrant	0.0004742	2.9335	0.0029089	28.9476	0.0001405	0.0860	0.0000297	0.2145	32.18	0.02
	Ellis	0.0029920	18.5096	0.0183544	182.6530	0.0008865	0.5426	0.0001873	1.3534	203.06	0.10
	Johnson	0.0007256	4.4888	0.0044512	44.2958	0.0002150	0.1316	0.0000454	0.3282	49.24	0.02
	Kaufman	0.0059718	36.9441	0.0366343	364.5651	0.0017695	1.0831	0.0003738	2.7012	405.29	0.20
	Parker	0.0000012	0.0076	0.0000075	0.0751	0.0000004	0.0002	0.0000001	0.0006	0.08	0.00
	Rockwall	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Henderson	0.0006908	4.2734	0.0042376	42.1700	0.0002047	0.1253	0.0000432	0.3125	46.88	0.02
	Hood	0.0050771	31.4088	0.0311454	309.9429	0.0015044	0.9208	0.0003178	2.2965	344.57	0.17
	Hunt	0.0088463	54.7268	0.0047066	46.8380	0.0002273	0.1391	0.0652823	471.8144	573.52	0.29
El Paso Area	El Paso	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
San Antonio Area	Bexar	0.0138906	85.9325	0.0009368	9.3227	0.0000452	0.0277	0.1109355	801.7639	897.05	0.45
	Comal	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Guadalupe	0.0032029	19.8143	0.0002160	2.1496	0.0000104	0.0064	0.0255795	184.8703	206.84	0.10
	Wilson	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Austin Area	Bastrop	0.0033782	20.8990	0.0002278	2.2673	0.0000110	0.0067	0.0269798	194.9906	218.16	0.11
	Caldwell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hays	0.0008331	5.1541	0.0000562	0.5592	0.0000027	0.0017	0.0066537	48.0881	53.80	0.03
	Travis	0.0051785	32.0364	0.0003493	3.4756	0.0000169	0.0103	0.0413577	298.9044	334.43	0.17
	Williamson	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
North East Texas Area	Gregg	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Harrison	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Rusk	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Smith	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Upshur	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Corpus Christi Area	Nueces	0.0128578	79.5431	0.0008672	8.6295	0.0000419	0.0256	0.1026870	742.1493	830.35	0.42
	San Patricio	0.0015100	9.3411	0.0001018	1.0134	0.0000049	0.0030	0.0120591	87.1543	97.51	0.05
Victoria Area	Victoria	0.0021192	13.1099	0.0001429	1.4223	0.0000069	0.0042	0.0169244	122.3174	136.85	0.07
Other ERCOT counties	Andrews	0.0000037	0.0232	0.0000230	0.2286	0.0039003	2.3873	0.0000002	0.0017	2.64	0.00
	Angelina	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Bosque	0.0022204	13.7364	0.0136212	135.5508	0.0006579	0.4027	0.0001390	1.0044	150.69	0.08
	Brazos	0.0024089	14.9022	0.0112305	111.7603	0.0005425	0.3320	0.0047829	34.5675	161.56	0.08
	Calhoun	0.0009466	5.8559	0.0000638	0.6353	0.0000031	0.0019	0.0075598	54.6366	61.13	0.03
	Cameron	0.0063536	39.3060	0.0004285	4.2642	0.0000207	0.0127	0.0507425	366.7307	410.31	0.21
	Cherokee	0.0027392	16.9455	0.0168033	167.2180	0.0008116	0.4968	0.0001714	1.2390	185.90	0.09
	Coke	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Coleman	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Crockett	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Ector	0.0019215	11.8872	0.0006604	6.5715	0.0911346	55.7813	0.0146527	105.8993	180.14	0.09
	Fannin	0.0000041	0.0251	0.0000249	0.2475	0.0000012	0.0007	0.0000003	0.0018	0.28	0.00
	Fayette	0.0051867	32.0869	0.0103217	102.7160	0.0004986	0.3052	0.0283993	205.2502	340.36	0.17
	Freestone	0.0047643	29.4740	0.0292268	290.8499	0.0014117	0.8641	0.0002982	2.1551	323.34	0.16
	Frio	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Grimes	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hardeman	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Haskell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hidalgo	0.0053716	33.2306	0.0003623	3.6051	0.0000175	0.0107	0.0428994	310.0466	346.89	0.17
	Howard	0.0002411	1.4916	0.0007641	7.6036	0.1283942	78.5870	0.0009490	6.8586	94.54	0.05
	Jack	0.0030783	19.0436	0.0188839	187.9227	0.0009121	0.5583	0.0001927	1.3924	208.92	0.10
	Jones	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Lamar	0.0040001	24.7464	0.0245388	244.1978	0.0011853	0.7255	0.0002504	1.8094	271.48	0.14
	Limestone	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Llano	0.0040314	24.9401	0.0002719	2.7057	0.0000131	0.0080	0.0321966	232.6946	260.35	0.13
	McLennan	0.0056576	35.0002	0.0347066	345.3824	0.0016764	1.0261	0.0003541	2.5591	383.97	0.19
	Milam	0.0012686	7.8481	0.0000856	0.8514	0.0000041	0.0025	0.0101316	73.2238	81.93	0.04
	Mitchell	0.0000311	0.1926	0.0001910	1.9003	0.0324260	19.8472	0.0000019	0.0141	21.95	0.01
	Nolan	0.0000293	0.1810	0.0001795	1.7860	0.0304745	18.6527	0.0000018	0.0132	20.63	0.01
	Palo Pinto	0.0036129	22.3510	0.0221635	220.5601	0.0010705	0.6552	0.0002261	1.6342	245.20	0.12
	Pecos	0.0000020	0.0122	0.0000121	0.1203	0.0020520	1.2560	0.0000001	0.0009	1.39	0.00
	Presidio	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Red River	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Robertson	0.0039506	24.4397	0.0055755	55.4842	0.0002693	0.1648	0.0246170	177.9140	258.00	0.13
	Taylor	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Titus	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Tom Green	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Upton	0.0000025	0.0157	0.0000156	0.1553	0.0026494	1.6217	0.0000002	0.0012	1.79	0.00
	Ward	0.0001995	1.2343	0.0012239	12.1801	0.2078335	127.2099	0.0000125	0.0902	140.71	0.07
	Webb	0.0042017	25.9935	0.0002834	2.8200	0.0000137	0.0084	0.0335565	242.5231	271.34	0.14
	Wharton	0.0021095	13.0502	0.0001423	1.4158	0.0000069	0.0042	0.0168474	121.7608	136.23	0.07
	Wichita	0.0000121	0.0749	0.0000743	0.7395	0.0126190	7.7238	0.0000008	0.0055	8.54	0.00
	Wilbarger	0.0179710	111.1755	0.1102430	1097.0811	0.0053249	3.2593	0.0011247	8.1288	1219.64	0.61
	Wise	0.0010202	6.3112	0.0062583	62.2792	0.0003023	0.1850	0.0000638	0.4615	69.24	0.03
	Young	0.0071054	43.9567	0.0435880	433.7654	0.0021054	1.2886	0.0004447	3.2140	482.22	0.24
	Total	**0.4414501**	**2730.9774**	**0.4812863**	**4789.5112**	**0.5345786**	**327.2027**	**0.6829349**	**4935.7718**	12783.46	**6.39**
Energy Savings (MWh)		6,186		9,951		612		7,227			

Table 29: Annual and OSD Electricity Savings for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	0	21,748	55,268	93,760	153,171	213,417	274,548	336,614	399,668	463,763	528,956	595,303	662,861
ESL-Multifamily (MWh)	0	50,218	94,867	167,566	262,939	357,885	452,435	546,620	640,469	734,013	827,282	920,305	1,013,111
ESL-Commercial (MWh)	0	0	25,750	54,550	82,773	111,399	140,452	169,957	199,937	230,420	261,430	292,996	325,145
PUC (SB7) (MWh)	0	538,841	976,984	1,437,883	1,831,318	2,205,082	2,560,158	2,897,479	3,217,935	3,522,368	3,811,579	4,086,330	4,347,343
SECO (MWh)	0	235,216	293,537	509,616	714,891	909,903	1,095,163	1,271,161	1,438,359	1,597,197	1,748,093	1,891,444	2,027,628
Wind-ERCOT (MWh)	0	3,273,150	8,135,429	10,995,427	13,049,580	13,560,301	14,091,009	14,642,488	15,215,550	15,811,039	16,429,835	17,072,848	17,741,026
SEER13-Single Family (MWh)	0	343,330	326,163	309,855	294,362	279,644	265,662	252,379	239,760	227,772	216,383	205,564	195,286
SEER13-Multifamily (MWh)	0	29,021	27,569	26,191	24,881	23,637	22,456	21,333	20,266	19,253	18,290	17,376	16,507
Total Annual (MWh)	0	4,491,524	9,935,568	13,594,848	16,413,917	17,661,268	18,901,882	20,138,030	21,371,943	22,605,825	23,841,849	25,082,165	26,328,906

PROGRAM	OZONE SEASON DAY - OSD												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family (MWh)	0	124	283	468	626	787	951	1,117	1,286	1,457	1,632	1,810	1,992
ESL-Multifamily (MWh)	0	233	460	744	999	1,254	1,508	1,760	2,012	2,263	2,514	2,764	3,013
ESL-Commercial (MWh)	0	0	71	149	227	305	385	466	548	631	716	803	891
PUC (SB7) (MWh)	0	1,476	2,677	3,939	5,017	6,041	7,014	7,938	8,816	9,650	10,443	11,195	11,911
SECO (MWh)	0	644	804	1,396	1,959	2,493	3,000	3,483	3,941	4,376	4,789	5,182	5,555
Wind-ERCOT (MWh)	0	14,246	23,054	27,654	33,273	34,575	35,929	37,335	38,796	40,314	41,892	43,532	45,235
SEER13-Single Family (MWh)	0	2,445	2,323	2,207	2,097	1,992	1,892	1,798	1,708	1,622	1,541	1,464	1,391
SEER13-Multifamily (MWh)	0	195	186	176	167	159	151	144	136	130	123	117	111
Total OSD (MWh)	0	19,365	29,857	36,734	44,366	47,607	50,830	54,039	57,242	60,444	63,651	66,867	70,099

Table 30: Annualand OSD NOx Emissions Reduction Values for the Different Programs (Base Year 2008)

PROGRAM	ANNUAL (in tons NOx)												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0	5	14	23	38	53	68	83	99	115	131	147	164
ESL-Multifamily	0	13	24	43	67	92	117	141	166	190	214	239	263
ESL-Commercial	0	0	6	14	21	28	35	42	50	57	65	73	81
PUC (SB7)	0	151	274	409	522	629	731	828	921	1,008	1,091	1,170	1,245
SECO	0	67	99	162	221	277	330	381	429	475	518	559	599
Wind-ERCOT	0	893	2,268	3,062	3,665	3,809	3,958	4,113	4,274	4,441	4,615	4,796	4,983
SEER13-Single Family	0	81	77	73	69	66	62	59	56	53	51	48	46
SEER13-Multifamily	0	7	6	6	6	6	5	5	5	5	4	4	4
Total Annual (Tons NOx)	0	1,217	2,769	3,790	4,609	4,959	5,307	5,653	5,999	6,344	6,690	7,036	7,384

PROGRAM	OZONE SEASON DAY - OSD (in tons NOx/day)												
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
ESL-Single Family	0.00	0.03	0.07	0.11	0.15	0.19	0.23	0.28	0.32	0.36	0.40	0.45	0.49
ESL-Multifamily	0.00	0.06	0.12	0.19	0.26	0.32	0.39	0.45	0.52	0.58	0.65	0.72	0.78
ESL-Commercial	0.00	0.00	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22
PUC (SB7)	0.00	0.41	0.75	1.12	1.43	1.72	2.00	2.27	2.52	2.76	2.99	3.21	3.41
SECO	0.00	0.18	0.27	0.44	0.60	0.76	0.90	1.04	1.18	1.30	1.42	1.53	1.64
Wind-ERCOT	0.00	3.94	6.42	7.63	9.32	9.69	10.06	10.46	10.87	11.29	11.74	12.19	12.67
SEER13-Single Family	0.00	0.57	0.54	0.51	0.49	0.46	0.44	0.42	0.40	0.38	0.36	0.34	0.32
SEER13-Multifamily	0.00	0.05	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03
Total OSD (Tons NOx)	0.00	5.24	8.23	10.09	12.35	13.26	14.16	15.07	15.97	16.86	17.76	18.66	19.57

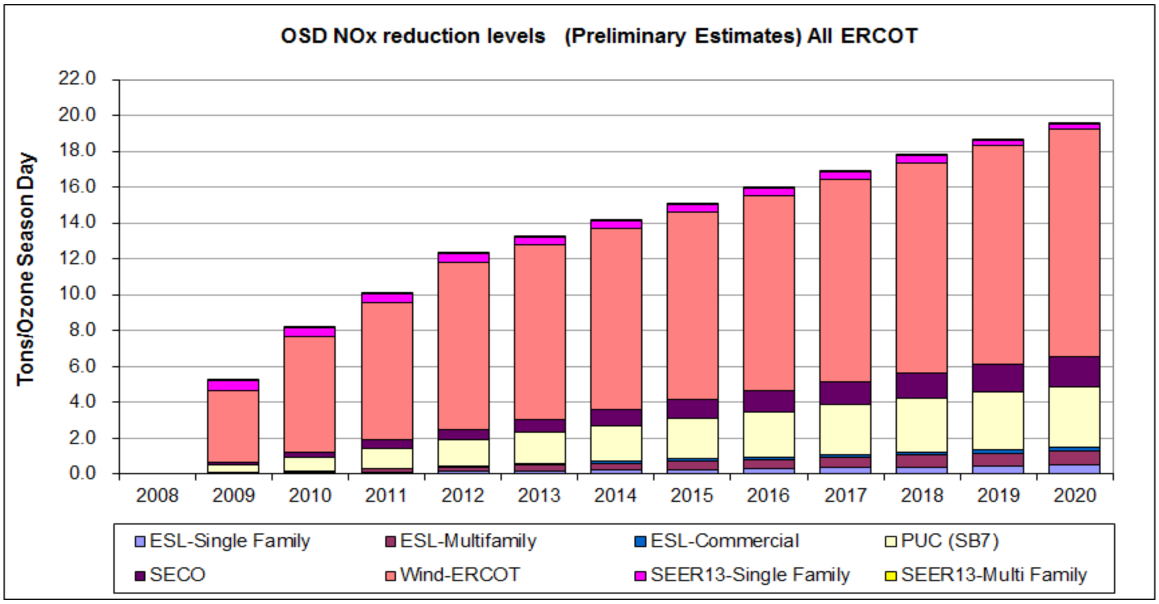

Figure 62: Integrated OSD NOx Emissions Reduction Projections through 2020 (Base Year 2008)

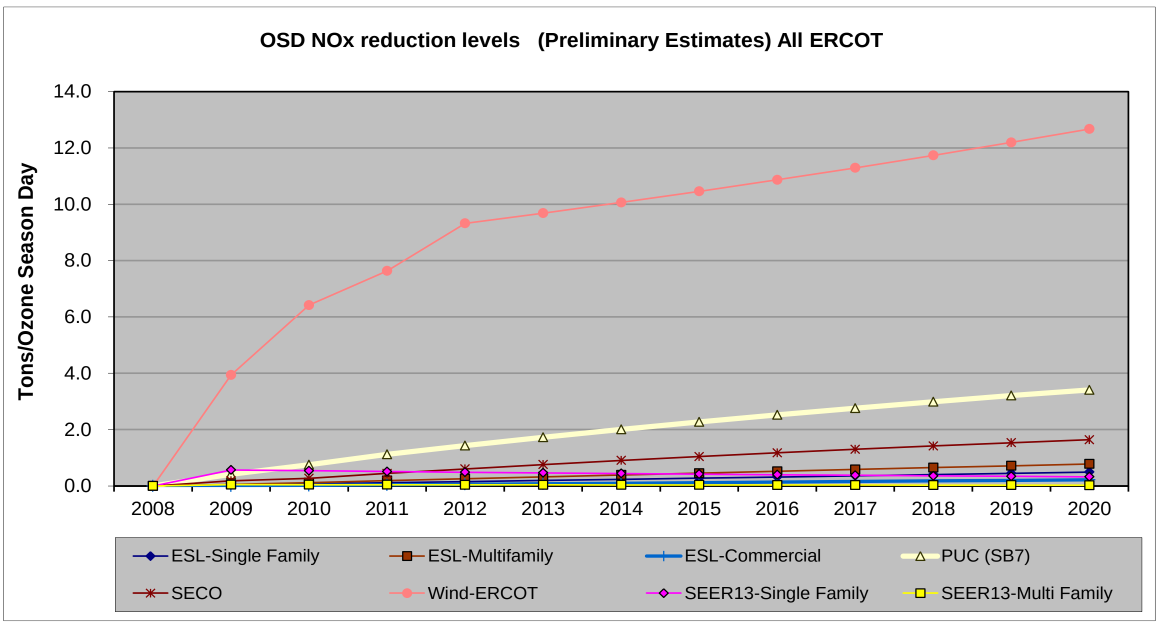

Figure 63: Integrated OSD Individual Programs NOx Emissions Reduction Projections through 2020 (Base Year 2008)

6. Verification of the IC3 software, AIM program and: eCALC calculator.

As part of the analysis effort, verification and validation efforts are carried out for each of the major analysis areas of the TERP activities., which could comprise on-site inspections, weather files update and calibrated simulations Next most siginificant activites complete in the solar Test Bench are reported, which record the weather that isuse to validat and develop calibrated simulations.

6.1 Solar Test Bench

This section introduces a series of activities that were carried out to adjust and retrofit the STB during the calendar year of 2012. Some sensors were calibrated and updated and some new sensors were installed to the STB. Also, the Multi-Pyranometer Array (MPA) was installed onto the bench and the methodology to measure normal incident solar radiation using MPA was studied. In addition, the STB structure has been painted to white. The wirings in mechanical room have been organized.

6.1.1 Solar Test Bench Setup

The whole STB setup has been detail described in the annual report for calendar year 2010. Thus, no more description about the setup is stated here, but the table for the sensor summary (**Error! Reference source ot found.**) is updated due to sensor changes. This table gives the sensor name, make, model and serial number along with the multiplier, offset and unit.

Table 31. List of the sensors updated to the end of 2012

Index Number	Sensor Name	Make	Model	Serial Number	Multiplier	Offset	Unit
1	TOA/RH[1]	Vaisala	HMP45A	D2430006	0.18	-40	° F
					0.10	NA	%
2	TOA/RH[2]	Vaisala	HMP155A	G3220004	0.18	-40	° F
					0.10	NA	%
3	WS/WD[1]	Met One	034B	H4735	1.79	0.629	MPH
					712.00	NA	Degree
4	WS/WD[2]	Met One	034B	M5048	1.79	0.629	MPH
					712.00	NA	Degree
5	LICOR[1]	Licor	Li-cor	PY24908	72.59	NA	W/m^2
6	LICOR[3]	Licor	Li-cor	PY15L25	75.59	NA	W/m^2
7	LICOR[4]	Licor	Li-cor	PY49745	75.03	NA	W/m^2
8	LICOR[5]	Licor	Li-cor	PY 74409	200.00	NA	W/m^2
9	LICOR[6]	Licor	Li-cor	PY 74438	200.00	NA	W/m^2
10	LICOR[7]	Licor	Li-cor	PY 74439	200.00	NA	W/m^2
11	LICOR[8]	Licor	Li-cor	PY 474450	200.00	NA	W/m^2
12	PSP[1]	Eppley	PSP	13673F3	125.63	NA	W/m^2
13	PSP[2]	Eppley	PSP	16881F3	103.09	NA	W/m^2
14	PSP[3]	Eppley	PSP	35417F3	112.74	NA	W/m^2
16	NIP[1]	Eppley	NIP	14851E6	118.06	NA	W/m^2
15	NIP[2]	Eppley	NIP	16620E6	117.79	NA	W/m^2
17	BW[1]	Eppley	8-48	20226	96.99	NA	W/m^2
18	BW[2]	Eppley	8-48	33886	98.62	NA	W/m^2
19	CO2	Telaire	NA	NA	0.97	-123	PPM

6.2 2011 Year Summary of Activities

6.2.1 Wind Set Calibration

The wind set with the serial number of H4735 has some problems for the wind direction due to the potentiometer failure. The sensor was sent to the manufacture Met One Instruments to repair and calibrate on 3/22/2012, and received on 4/16/2012.

6.2.2 Installation of PSP3

A new PSP, named as PSP[3], was installed next to PSP[1] and at the same altitude (see Figure 64). The two sensors are pointed out in the picture. Figure 65 shows the comparison between two PSPs measurement for one week.

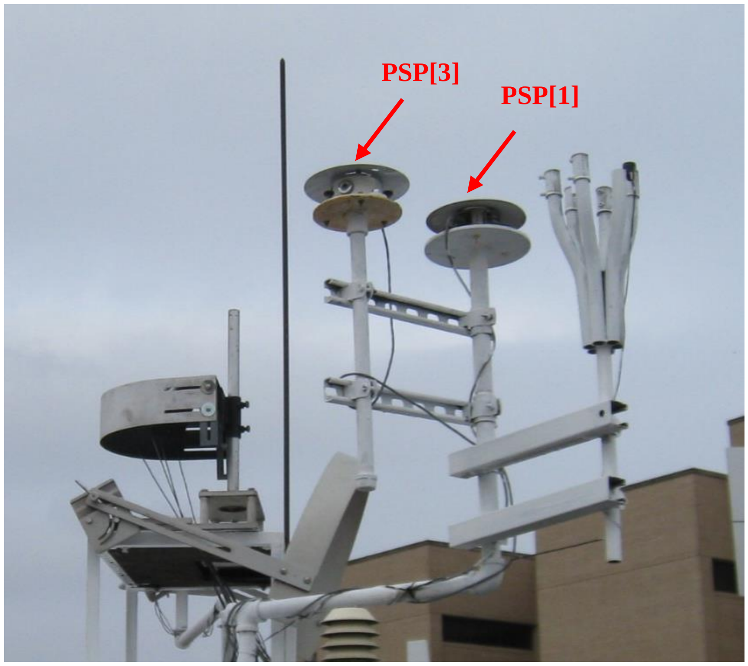

Figure 64: New installed PSP

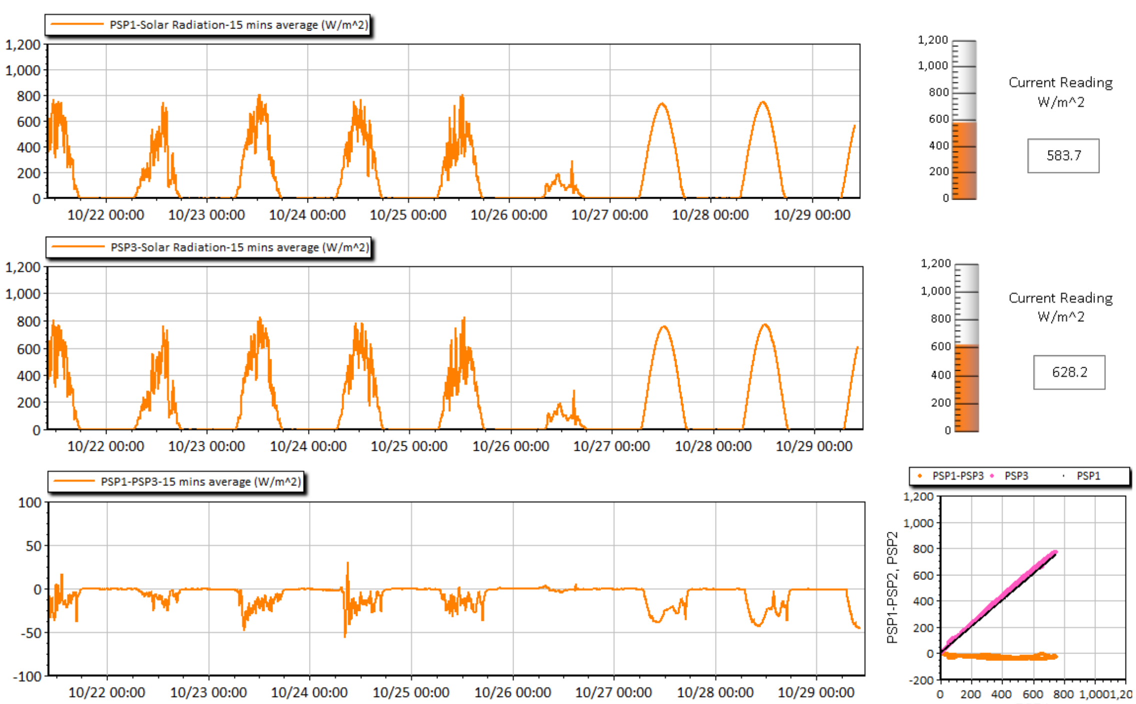

Figure 65: Comparison between the measurements from PSP[1] and PSP[3]

6.2.3 Paint for STB Structure

The STB has been painted to be white, and the pictures before and after painted are shown in **Error! eference source not found.** and Figure *67*.

Figure 66: The whole STB before painted

Figure 67: The whole STB after painted.

6.2.4 Wiring Organization

Figure 68 and Figure 69 show the pictures of data logger before and after wiring organization.

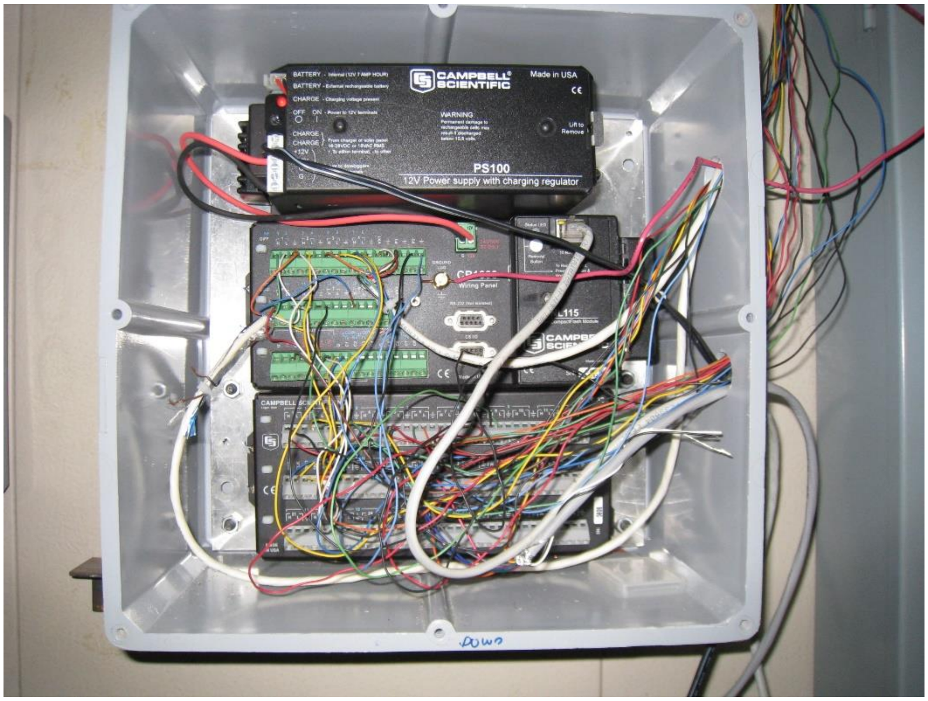

Figure 68: Data logger before wiring organization.

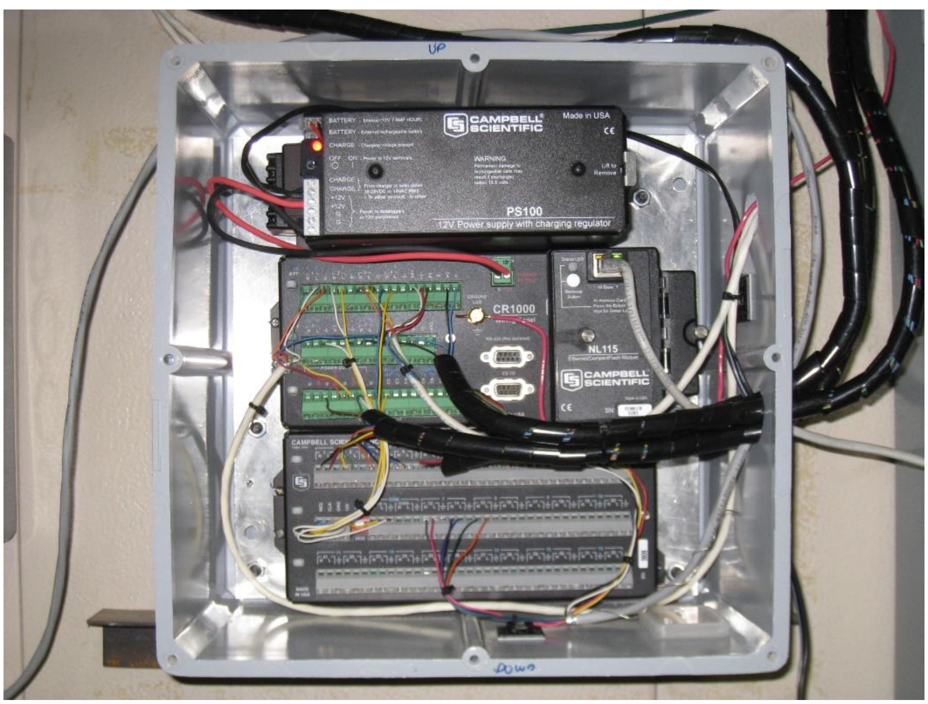

Figure 69: Data logger after wiring organization.

6.2.5 MULTI-PYRANOMETER ARRAY

The MPA consists of 4 LI-COR sensors: one sensor mounded horizontally, one 40 degree tilted sensor facing south, one 40 degree tilted sensor facing 60 degree east of south, and one 40 degree tilted sensor facing 60 degree west of south. And a shadow band is applied as an artificial horizon to block the reflected sunlight coming from the ground. The location, sensors and devices for MPA are shown in Figure 70 to Figure 72.

Figure 70: The Solar Test Bench after MPA installed

Figure 71: MPA structure

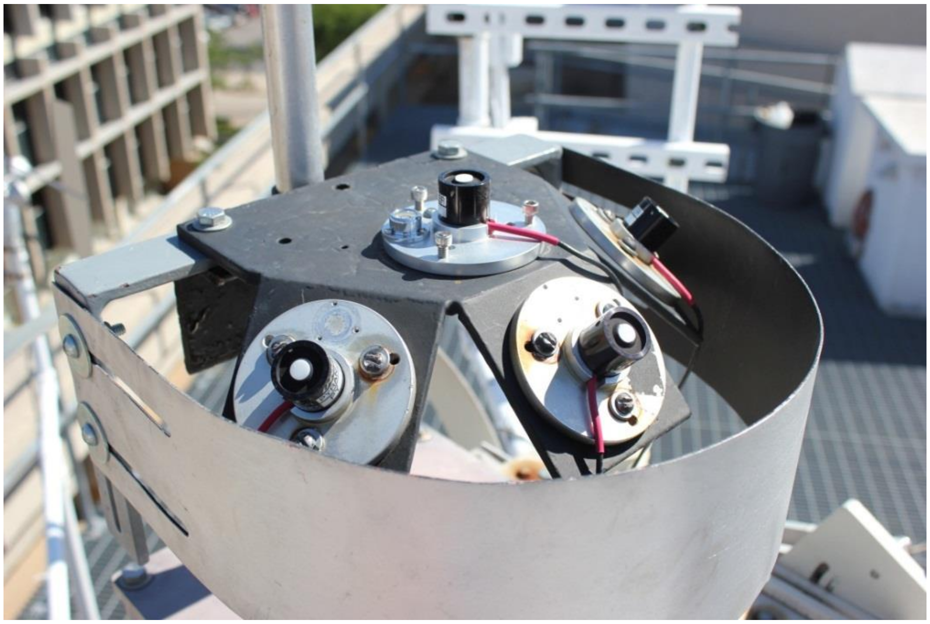

Figure 72: Placement of the 4 LI-CORs of MPA

6.3 Summary

- A new PSP has been installed next to PSP[1] and their measurements are compared.
- The whole Solar Test Bench structure has been cleaned and painted to be white.
- The wirings in the mechanical room have been organized.
- One wind sensor has been calibrated.
- Multi-Pyranometer Array has been installed on the bench to calculate normal incident solar radiation.

6.4 Acknowledgements

This task could not be completed without the help of many students among another Mr. Keehan Kim, Mr.Sunglok Do, Ms. Chunliu Mao and Mr. Stephen O' Neal from ESL, TAMU. Also the advice of Mr. Tom Kirk from EPPLEY Inc. was well appreciated.

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8.1 Appendix

This appendix presents an example of a method to evaluate the NOx emissions savings from the energy-efficiency programs. The ESL-Single Family program which is one of the energy-efficiency programs is selected to show the example. The following describes how data of the ESL-Single Family program are managed for the Integrated Savings process. In addition, Figure **A-6** shows the overall flow diagram to manage the files processed in Integrated Savings.

1. Programs: The ESL-Single Family program is used for this example.

2. For savings/Generation Data: See the excel file “Singlefamily Data.xls”; Use the tab “2012 Data” which has the corresponding 2010 annual/OSD savings data based on 2008 base year generated by simulation[43]. Figure A-1 shows a screen-shot for the 2012 annual/OSD savings data.

3. The 2010 Annual & OSD eGrid: The ESL-Single Family program has two worksheet files for emissions factors; one for annual and the other for the OSD period pre-calculated emissions factors estimated from 2010 USEPA eGrid for Texas. The 2010 Annual & OSD eGrid files are “Singlefamily(annual_2010eGrid_25%).xls” and “Singlefamily(OSD_2010eGrid_25%).xls”, respectively. Figure A-2 shows the table of annual 2010 eGrid emissions factors using in Integrated Savings.

4. NOx Reductions & Projection for Different Programs: It can be found in the file “Singlefamily savings and projection.xls” that projected energy savings and NOx reductions for the ESL-Single Family program using 2010 eGrid emission factors. In the tab “Energy & NOx Savings Summary”, the energy savings summary projection plots are available, shown in Figure A-3.

5. Integrated NOx Reductions & Projection: Integrated NOx Reductions & Projection from all different programs are obtained by using the excel workspace[44] named as “Integrated Savings (2010eGrid).xlw”, which is to merge the results of all different programs. Figure A-4 shows a screen shot of example results using the excel workspace file.

6. Result of Integrated NOx Reductions & Projection: The resultant excel file “Integrated Savings Summary (2010eGrid).xls” is generated automatically by running “Integrated Savings Executable.xlw” and is located at the front of the worksheets shown in Figure A-4. The NOx emission reductions plots are under the tab “Energy & NOx Summary”, shown in Figure A-5.

[43] Most of the energy-efficiency programs have a separate excel file for their savings data input. However, the PUC SB7 and the Commercial Buildings programs have their savings data in the excel files named as “PUC SB7 savings and projection” and “Commercial savings and projection”, respectively.

[44] Microsoft Excel 2003 is recommended to run the excel workspace file.

	2008 Base Year	
	2012 permits	
	MWh	MWh/OSD
ANDERSON	4.82	0.01
ANDREWS	54.55	0.15
ANGELINA	44.15	0.12
ARANSAS	81.12	0.22
ARCHER	4.30	0.01
ATASCOSA	45.94	0.13
AUSTIN	16.81	0.05
BANDERA	-	-
BASTROP	40.65	0.11
BAYLOR	-	-
BEE	7.62	0.02
BELL	1,644.32	4.50
BEXAR	2,498.22	6.84
BLANCO	2.15	0.01
BORDEN	15.71	0.04
BOSQUE	1.78	0.00
BRAZORIA	1,535.80	4.21
BRAZOS	581.89	1.59
BREWSTER	7.14	0.02
BRISCOE	8.83	0.02
BROOKS	-	-
•		
•		
•		
•		
VAN ZANDT	5.74	0.02
VICTORIA	93.99	0.26
WALLER	6.40	0.02
WARD	10.10	0.03
WASHINGTON	28.01	0.08
WEBB	590.28	1.62
WHARTON	64.35	0.18
WICHITA	126.76	0.35
WILBARGER	-	-
WILLACY	35.77	0.10
WILLIAMSON	2,529.13	6.93
WILSON	23.48	0.06
WINKLER	2.02	0.01
WISE	33.29	0.09
YOUNG	28.83	0.08
ZAPATA	-	-
ZAVALA	5.51	0.02
TOTAL	75,591.15	207.10

Figure A-1. Screen-shot of the 2012 Annual/OSD Savings Data for the "Singlefamily.xls" File.

Area	County	CM Zones								Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
		H		N		W		S			
Houston-Galveston Area	Brazoria	0.0562032	3295.2379	0.0000071	0.3023	0.0000003	0.0008	0.0005265	21.5564	3317.10	1.66
	Chambers	0.0204500	1199.0000	0.0000026	0.1100	0.0000001	0.0003	0.0001916	7.8435	1206.95	0.60
	Fort Bend	0.0313463	1837.8597	0.0000040	0.1686	0.0000002	0.0004	0.0002937	12.0227	1850.05	0.93
	Galveston	0.0226620	1328.6890	0.0000029	0.1219	0.0000001	0.0003	0.0002123	8.6918	1337.50	0.67
	Harris	0.1486911	8717.8782	0.0000189	0.7998	0.0000009	0.0021	0.0013930	57.0295	8775.71	4.39
	Liberty	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Montgomery	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Waller	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Beaumont/ Port Arthur Area	Hardin	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Jefferson	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Orange	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Dallas/ Fort Worth Area	Collin	0.0012932	75.8195	0.0079329	336.3120	0.0003832	0.8918	0.0000809	3.3134	416.34	0.21
	Dallas	0.0024826	145.5573	0.0152295	645.6476	0.0007356	1.7120	0.0001554	6.3611	799.28	0.40
	Denton	0.0001267	7.4264	0.0007770	32.9412	0.0000375	0.0873	0.0000079	0.3245	40.78	0.02
	Tarrant	0.0004742	27.8017	0.0029089	123.3199	0.0001405	0.3270	0.0000297	1.2150	152.66	0.08
	Ellis	0.0029920	175.4229	0.0183544	778.1222	0.0008865	2.0632	0.0001873	7.6662	963.27	0.48
	Johnson	0.0007256	42.5424	0.0044512	188.7053	0.0002150	0.5004	0.0000454	1.8592	233.61	0.12
	Kaufman	0.0059718	350.1342	0.0366343	1553.0882	0.0017695	4.1181	0.0003738	15.3014	1922.64	0.96
	Parker	0.0000012	0.0721	0.0000075	0.3198	0.0000004	0.0008	0.0000001	0.0032	0.40	0.00
	Rockwall	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Henderson	0.0006908	40.5008	0.0042376	179.6490	0.0002047	0.4763	0.0000432	1.7699	222.40	0.11
	Hood	0.0050771	297.6741	0.0311454	1320.3914	0.0015044	3.5011	0.0003178	13.0088	1634.58	0.82
	Hunt	0.0088463	518.6677	0.0047066	199.5352	0.0002273	0.5291	0.0652823	2672.6223	3391.35	1.70
El Paso Area	El Paso	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
San Antonio Area	Bexar	0.0138906	814.4172	0.0009368	39.7157	0.0000452	0.1053	0.1109355	4541.6419	5395.88	2.70
	Comal	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Guadalupe	0.0032029	187.7879	0.0002160	9.1576	0.0000104	0.0243	0.0255795	1047.2096	1244.18	0.62
	Wilson	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Austin Area	Bastrop	0.0033782	198.0679	0.0002278	9.6589	0.0000110	0.0256	0.0269798	1104.5367	1312.29	0.66
	Caldwell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hays	0.0008331	48.8470	0.0000562	2.3821	0.0000027	0.0063	0.0066537	272.3980	323.63	0.16
	Travis	0.0051785	303.6216	0.0003493	14.8063	0.0000169	0.0393	0.0413577	1693.1625	2011.63	1.01
	Williamson	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
North East Texas Area	Gregg	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Harrison	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Rusk	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Smith	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Upshur	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
Corpus Christi Area	Nueces	0.0128578	753.8617	0.0008672	36.7627	0.0000419	0.0975	0.1026870	4203.9512	4994.67	2.50
	San Patricio	0.0015100	88.5298	0.0001018	4.3172	0.0000049	0.0114	0.0120591	493.6911	586.55	0.29
Victoria Area	Victoria	0.0021192	124.2478	0.0001429	6.0590	0.0000069	0.0161	0.0169244	692.8745	823.20	0.41
Other ERCOT counties	Andrews	0.0000037	0.2195	0.0000230	0.9738	0.0039003	9.0770	0.0000002	0.0096	10.28	0.01
	Angelina	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Bosque	0.0022204	130.1852	0.0136212	577.4618	0.0006579	1.5312	0.0001390	5.6893	714.87	0.36
	Brazos	0.0024089	141.2344	0.0112305	476.1113	0.0005425	1.2624	0.0047829	195.8097	814.42	0.41
	Calhoun	0.0009466	55.4989	0.0000638	2.7064	0.0000031	0.0072	0.0075598	309.4926	367.71	0.18
	Cameron	0.0063536	372.5184	0.0004285	18.1661	0.0000207	0.0482	0.0507425	2077.3692	2468.10	1.23
	Cherokee	0.0027392	160.5988	0.0168033	712.3673	0.0008116	1.8889	0.0001714	7.0184	881.87	0.44
	Coke	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Coleman	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Crockett	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Ector	0.0019215	112.6596	0.0006604	27.9954	0.0911346	212.0953	0.0146527	599.8731	952.62	0.48
	Fannin	0.0000041	0.2377	0.0000249	1.0546	0.0000012	0.0028	0.0000003	0.0104	1.31	0.00
	Fayette	0.0051867	304.1005	0.0103217	437.5816	0.0004986	1.1603	0.0283993	1162.6524	1905.49	0.95
	Freestone	0.0047643	279.3370	0.0292268	1239.0533	0.0014117	3.2854	0.0002982	12.2074	1533.88	0.77
	Frio	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Grimes	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hardeman	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Haskell	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Hidalgo	0.0053716	314.9397	0.0003623	15.3583	0.0000175	0.0407	0.0428994	1756.2786	2086.62	1.04
	Howard	0.0002411	14.1369	0.0007641	32.3923	0.1283942	298.8085	0.0009490	38.8512	384.19	0.19
	Jack	0.0030783	180.4839	0.0188839	800.5716	0.0009121	2.1228	0.0001927	7.8874	991.07	0.50
	Jones	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Lamar	0.0040001	234.5315	0.0245388	1040.3099	0.0011853	2.7584	0.0002504	10.2494	1287.85	0.64
	Limestone	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Llano	0.0040314	236.3670	0.0002719	11.5266	0.0000131	0.0306	0.0321966	1318.1132	1566.04	0.78
	McLennan	0.0056576	331.7109	0.0347066	1471.3680	0.0016764	3.9014	0.0003541	14.4963	1821.48	0.91
	Milam	0.0012686	74.3794	0.0000856	3.6272	0.0000041	0.0096	0.0101316	414.7807	492.80	0.25
	Mitchell	0.0000311	1.8251	0.0001910	8.0956	0.0324260	75.4641	0.0000019	0.0798	85.46	0.04
	Nolan	0.0000293	1.7153	0.0001795	7.6084	0.0304745	70.9225	0.0000018	0.0750	80.32	0.04
	Palo Pinto	0.0036129	211.8294	0.0221635	939.6106	0.0010705	2.4914	0.0002261	9.2573	1163.19	0.58
	Pecos	0.0000020	0.1155	0.0000121	0.5123	0.0020520	4.7756	0.0000001	0.0050	5.41	0.00
	Presidio	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Red River	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Robertson	0.0039506	231.6253	0.0055755	236.3690	0.0002693	0.6267	0.0246170	1007.8051	1476.43	0.74
	Taylor	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Titus	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Tom Green	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.0000000	0.0000	0.00	0.00
	Upton	0.0000025	0.1491	0.0000156	0.6615	0.0026494	6.1660	0.0000002	0.0065	6.98	0.00
	Ward	0.0001995	11.6980	0.0012239	51.8886	0.2078335	483.6857	0.0000125	0.5112	547.78	0.27
	Webb	0.0042017	246.3505	0.0002834	12.0135	0.0000137	0.0319	0.0335565	1373.7872	1632.18	0.82
	Wharton	0.0021095	123.6824	0.0001423	6.0315	0.0000069	0.0160	0.0168474	689.7218	819.45	0.41
	Wichita	0.0000121	0.7103	0.0000743	3.1505	0.0126190	29.3679	0.0000008	0.0310	33.26	0.02
	Wilbarger	0.0179710	1053.6544	0.1102430	4673.6888	0.0053249	12.3926	0.0011247	46.0463	5785.78	2.89
	Wise	0.0010202	59.8140	0.0062583	265.3166	0.0003023	0.7035	0.0000638	2.6140	328.45	0.16
	Young	0.0071054	416.5953	0.0435880	1847.8893	0.0021054	4.8998	0.0004447	18.2058	2287.59	1.14
	Total	**0.4414501**	**25882.5686**	**0.4812863**	**20403.8553**	**0.5345786**	**1244.1113**	**0.6829349**	**27958.9893**	75489.52	**37.74**
Energy Savings (MWh)		58,631		42,394		2,327		40,939			

Figure A-2. 2010 USEPA eGrid Annual Emissions Factors.

Energy savings summary: (program wise)

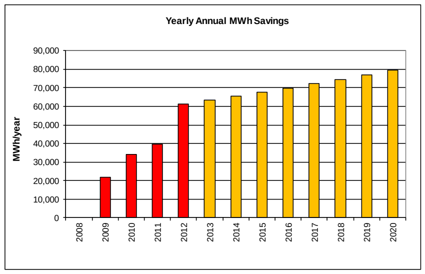
Base year	**2008**
Projection year	**2020**

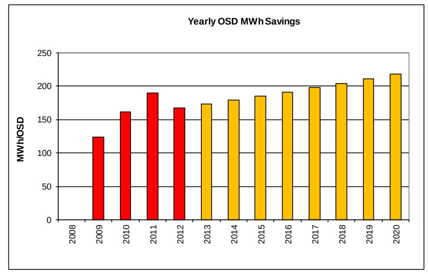
Adjustment factors

Annual degradation factor[5]	2.00%
T&D loss	7.00%
Initial discount factor[6]	20.00%
Growth factor	3.30%

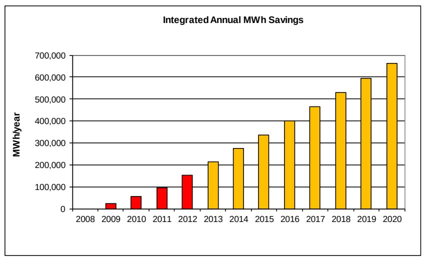
Energy Savings Summary

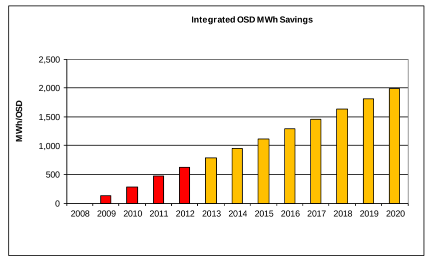
Year	Total Yearly Energy Savings	
	Electricity	
	Annual (MWh)	Ozone Season Day (MWh/day)
1999	0	0
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0
2007	0	0
2008	0	0
2009	21,748	124
2010	33,955	161
2011	39,597	190
2012	61,287	168
2013	63,309	173
2014	65,399	179
2015	67,557	185
2016	69,786	191
2017	72,089	198
2018	74,468	204
2019	76,926	211
2020	79,464	218



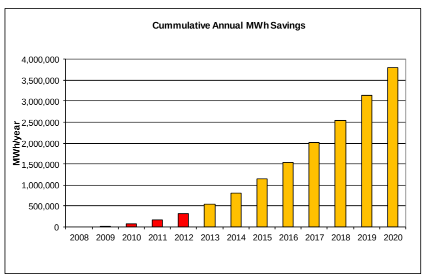


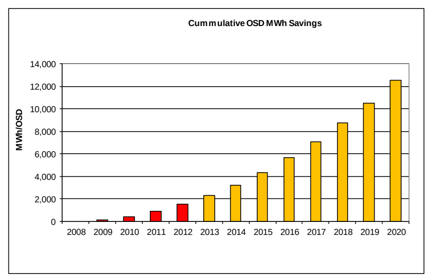
Year	Total Integrated Energy Savings	
	MWh	Ozone Season Day (MWh/day)
1999	0	0
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0.00
2007	0	0.00
2008	0	0.00
2009	21,748	124.37
2010	55,268	283.25
2011	93,760	468
2012	153,171	626
2013	213,417	787.25
2014	274,548	950.68
2015	336,614	1,116.75
2016	399,668	1,285.61
2017	463,763	1,457.40
2018	528,956	1,632.28
2019	595,303	1,810.39
2020	662,861	1,991.89





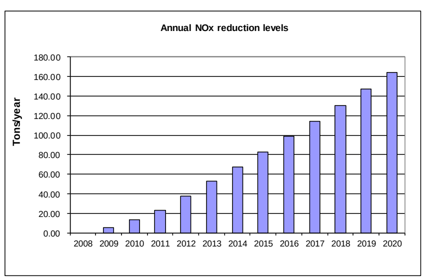
Year	Total Cummulative Energy Savings	
	MWh	Ozone Season Day (MWh/day)
1999	0	0
2000	0	0
2001	0	0
2002	0	0
2003	0	0
2004	0	0
2005	0	0
2006	0	0.00
2007	0	0.00
2008	0	0.00
2009	21,748	124.37
2010	77,017	407.62
2011	170,776	875.39
2012	323,948	1,501.71
2013	537,365	2,288.96
2014	811,913	3,239.64
2015	1,148,526	4,356.39
2016	1,548,194	5,642.00
2017	2,011,957	7,099.40
2018	2,540,914	8,731.67
2019	3,136,216	10,542.06
2020	3,799,077	12,533.95





NOx Savings Summary

Year	Total NOx emissions reduction (Tons) (2007 25% annual and ozone season eGrid)	
	Electric	
	Annual	Ozone Season Day
2005	0.00	0.00
2006	0.00	0.00
2007	0.00	0.00
2008	0.00	0.00
2009	5.41	0.03
2010	13.62	0.07
2011	23.05	0.11
2012	37.74	0.15
2013	52.65	0.19
2014	67.77	0.23
2015	83.13	0.28
2016	98.73	0.32
2017	114.58	0.36
2018	130.71	0.40
2019	147.12	0.45
2020	163.83	0.49



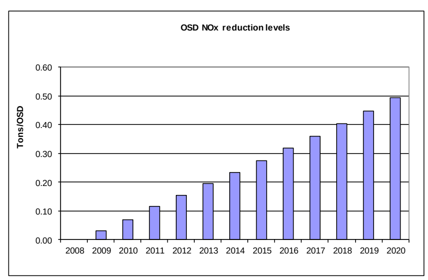


Figure A-3. Screen-shot of Selected Energy Savings and NOx Reductions Projections for the ESL-Single Family Program

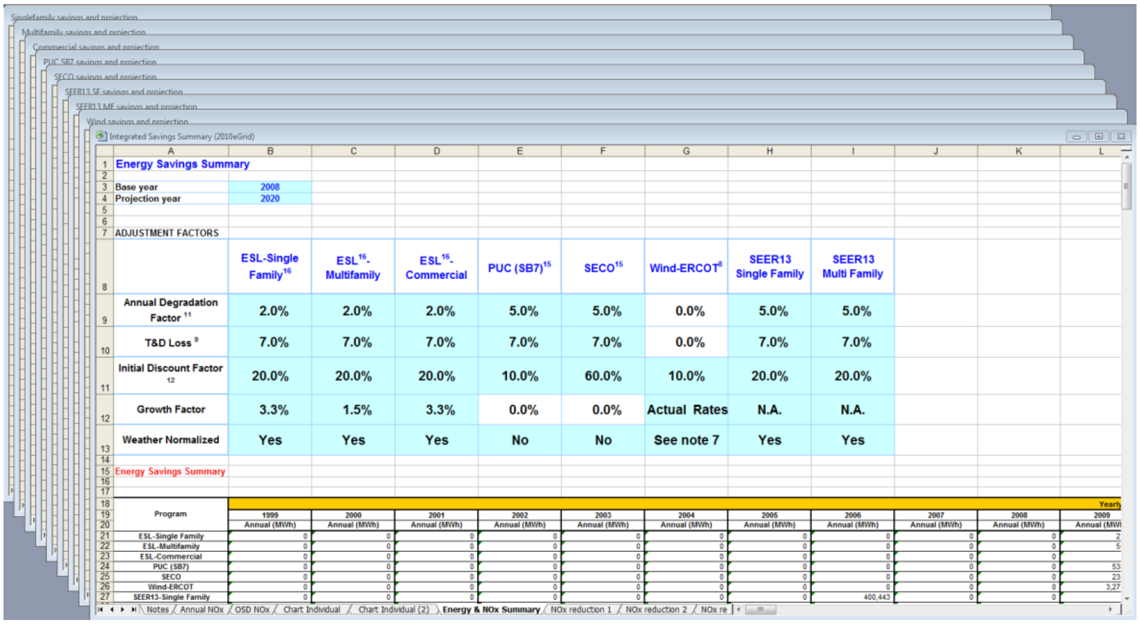


Figure A-4. Screen-shot of the Excel Workspace, “Integrated Savings (2010eGrid).xlw”

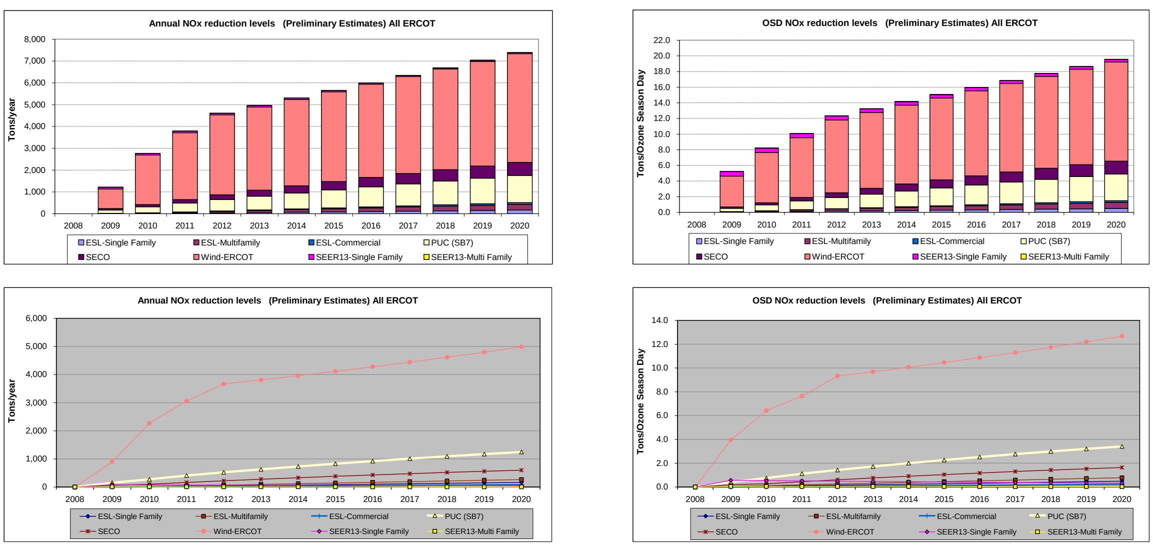
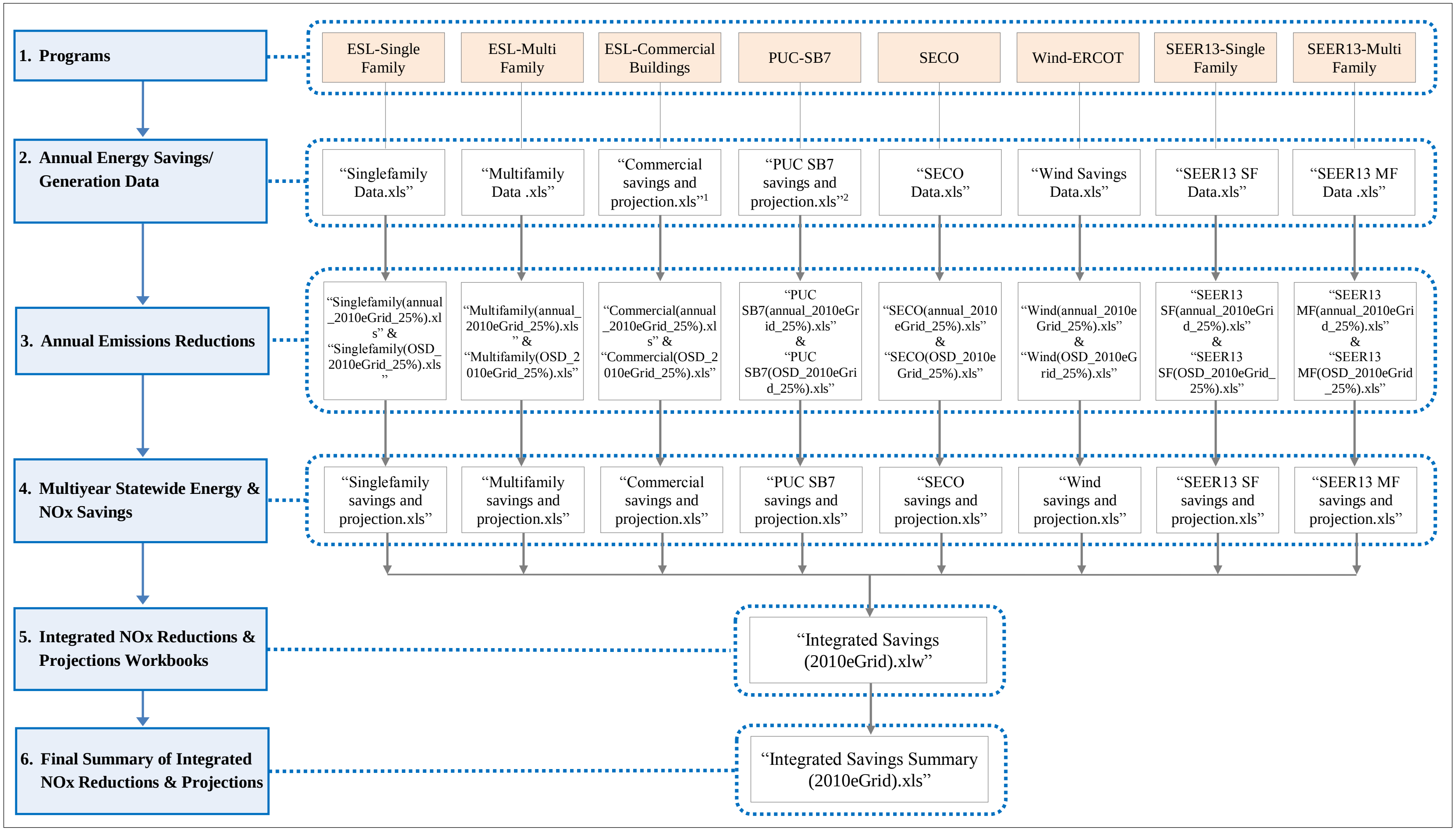


Figure A-5. Screen-shot of NOx Emission Reductions Plots under the Tab, “Energy & NOx Savings Summary” in the Worksheet “Integrated Savings Summary.xls”



Note: 1. Energy savings data for commercial buildings are found in two excel files: Commercial Data.xls & Commercial savings and projection.xls.
2. Energy savings data for PUC SB7 are found in their savings and projection excel files.
3. The emissions factors contained in eGRID used for electricity savings only.

Figure A-6. Overall Flow Diagram for the Files Processed in Integrated Savings